INCREASING OF RECREATIONAL POTENTIAL HAND IN HAND WITH SUSTAINABLE DEVELOPMENT OF CADASTRAL AREA OF SMALL TOWN

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Abstract
Nature lovers have long argued that natural environment play an important role if not the key role in human health. This paper studies landscape with a focuse on recreational potential of cadastral area of small town Lipany, east Slovakia. Together with the construction of aquapark and other recreational facilities, the town seeks to increase the recreational potential of the area. However, raising tourist offer should go hand in hand with the sustainable development of the area defined by its three pillars: economical, social and environmental.
The work assesses the current recreational potential of the place according to two methodologies and it defines values and problems of the landscape based on a comprehensive analysis of the area. Next, there are proposed changes in the study landscape taking into account recreation as well as sustainable development of the area. The proposed changes are polyfunctional, they do not only increase the recreational potential of the area and thus the tourists increase, but they also increase ecological stability, production potential of the landscape, potential well-being and health of its inhabitants and they protect and revitalize the values and eliminate identified problems in the area.

Key words: recreation, health, sustainability, landscape proposal, landscape planning

Introduction

Nature advocates and nature lovers have long argued that parks and other natural environment play an important, if not a key, role in human health. In their time, popular writers, leaders such as Thoreau, Muir, and Olmsted, have argued that contact with nature is important for psychological, physical and spiritual health (Kuo 2010). These views are also confirmed today by many scientific studies (Kuo 2010, Maas 2008, Li 2010). When people's attention is easily and effortlessly held by natural scenes, reffered as “soft fascination”, pessimistic ideas are blocked and negative emotions are replaced by positive ones, which is assumed to play an important role in the restorative quality of nature (Maas 2008). Maller et al. (2005) present study at hospital patients in a room with nature-oriented windows who were recovered more quickly than those with brick-oriented windows. There are also evidences of therapeutic benefits that a person gains by being physically in the wild. Jurča (1983) considers walking and hiking in the most changeable atmosphere on the most changeable terrain as one of the most effective, the most varied and the most healthy types of movement, or ways of recreating and maintaining a healthy human being, as it can be done without any great preparation and without substantial material costs, and which employs all organs and leads to reinforcing them and increasing their adaptability to change and resilience.
Kuo (2010) proposes to increase the intake of vitamin G (G refers to green environment as a necessary ingredient in a healthy life) by people to provide as much nature, in as many forms, as possible, to bring nature to people and to bring people to nature by encouraging and recommending people to spend a considerable

amount of time in nature, creating a program for people in nature teaching them new ways of connecting with nature, providing more multifunctional facilities and furniture in nature and others.
This work deals with the cadastral area of the small town of Lipany in eastern Slovakia, where, along with the geothermal well, a few years ago appeared an interest in increasing the recreational potential of the area connected with the construction of aquapark and other recreational facilities. In order to achieve the higher recreational potential of the area and the physical and mental well-being of both visitors and domestic inhabitants, the development of the area should meet the requirements of sustainable development in terms of its three pillars, economic, social and last but not least, environmental.

Material and methods
The material for this research was the analysis of the primary, secondary and tertiary landscape structure of the cadastral area of the small town Lipany, sources of information about the area, as well as interviews with the competent persons in the area. The landscape consists of the valley of the river Torysa on sensitive fertile fluvisols, where predominantly settlement is situated, passing through rugged hill on a typical Carpathian flysh with cambisols where grassland prevails up to highly rugged highlands in the north of the area with rendzinas where forest predominates. Historically, the legend of old Slavic lime grove is connected with the area, of which the last seven limes have remained, but today there is only one old lime, which is protected. In the first half of the 20th century, the area was significantly cultivated with a lot of fruit alleys and orchards, as shown by the aerial mapping from 1950. The population has been growing in the town for several decades and the population trends are related to the building of houses and dwelling homes.
Methods of the research are other analysis of the area, such as definition of landscape types, ecological zonation of the area, identification of perceptual relations in the area, vulnerability of the area and evaluation of landscape character. Subsequently, from these analyses, values as well as problems of this area were summed up, and the recreational potential of the area was evaluated according to two chosen methodologies: Bina´s method (2010) and Carbol´s method (2010). Both methodologies indicate the final potential on the five-point scale. On the basis of these analyzes, there were proposed changes in the country in order to increase the recreational potential of the area so that the proposed elements in the country operate multifunctionally and meet the requirements of sustainable development defined in three pillars.

Results
The basic summary of the results of the research includes the identification of values and problems in the area and evaluation of the recreational potential. Hydrological and terrestrial biocorridors are natural values of the area, among cultural and historical values there are churches, chapels, wooden crosses, protected lime tree, alleys, old orchards, and view horizons, sightseeing spots, and mirroring water surface of lakes are aesthetic values. In the area, there are problems with ecological stability, related to the insufficient function of the biocorridors of supraregional significance, problems with preservation of cultural and historical values, such as incomplete and unsupervised alleys of fruit trees, inappropriate woody vegetation in sacral land, problems from the point of view of the residential function of environment, problems of negative visual dominants, problems of urban plans and landscape character protection and problems in terms of degradation of local food

production. The area also has a very low recreational potential at present, according to Bina (2010), the potential is at level 2 - limited, with a low level of activity and according to Carbol (2010) the potential is also at level 2 - according to him at the basic, sufficient level.
For the proposed status, a new recreational potential was re-evaluated, indicating an increase in Bina´s method (2010) from level 2 to level 3 - moderate potential and in Carbol´s method (2010) from level 2 to level 3 - potential at an elevated level.
The proposed elements in the country include, in addition to the aquapark, a sensory garden, which aims to give people space on a small area where the effect of nature on their senses would be increased and in this way to build a relationship people with nature but also to heal, to teach and to provide a space for creating social connections.
There are also proposed walking trails surrounded by alleys of fruit trees in the countryside on the ridges of grassland hills, from which unique remote views can be found. The goal is to give this place an identity, to make these areas more attractive and to encourage visitors, both locals and tourists, to walk through this area. Alleys also defeat some negative visual effects in the territory, as high transmitter on the hill, they support biodiversity on large grasslands and enhance country's productive potential. In addition to the walking trails, the educational route, cycling routes, cross-country skiing tracks and bicycle and cross-country skiing rentals are proposed.
On the basis of the analysis of perceptions, a specific place was clearly identified, where a view suddenly opens across the valley to remote castle on the cliff. At this place, it is proposed to create a symbolic recreational element, a lime grove, the effectiveness of this view would be intensified by looking from a space enclosed to a space widely open through the crowns of lime trees. Next, on one of the valuable identified sightseeing sites, building of an observation tower is proposed.
The axis of the hydrologic biocorridor of the river Torysa, formed by natural vegetation of predominant skeletal species *Salix sp.* and *Alnus glutinosa* is not maintained especially in the part where it passes through the town and the industrial zone. There is proposed to complement the tree structure, which would at the same time defeat negative effect of visually ungainly industrial area and high chimneys. Another proposed element for enhancing the ecological stability of the area is to create part of the forest as forest with supported recreational function, where the management of these sites would be strictly directed, as well as the species and spatial structure of the forest would more respond to potential biota. In three identified recreational areas located at the contact points of the settlement with the countryside along the valley of the rivers, vegetation and facilities supporting recreation are also proposed.
It is also proposed to care about the cultural and historical values by adjusting the surroundings of wooden crosses in the country by planting *Tilia cordata* instead of insufficiently representative *Thuja occidentalis* and revitalizing existing fruit alleys and old orchards. It is also proposed to create a new orchard based on the history of fruit trees in the area.

Discussion

Recreation as a recovery of man's power is relatively difficult to grasp. Nevertheless, there are methodologies to define which country is appropriate for recreation and healing processes. In this work, two methodologies were chosen, the well-known Bina´s method (2010), has relative objectivity and good comparability, but its drawback is insufficient extensibility, thus the second method was chosen, Carbol´s

method (2010), which is more detailed, and its advantage is the elaborated evaluation of the recreational potential not only for the incoming tourists but also for the recreation of the local inhabitants. However both methodologies do not assess urban structure and architectural expression of the objects, their unity and harmony with the landscape, feeling of what people have from a certain place (*genius loci*), or a degree of affectional bond between people and the place, which ultimately makes the place unique, rare, unrepeatable and therefore very attractive.

The increase of the recreational potential by the proposed modifications in the area is documented by using methodologies as well as by the assumed effect that the proposed elements should bring to the people in the territory. The sensory garden, recreational areas, and forest with a supported recreational function are designed to entice people to stay in the natural environment and to act as ecotherapy. The walking alleys, educational route, cycling routes, cross-country skiing tracks with destination places, such as the lime grove or the observation tower, are designed not only to increase population mobility and thus their physical condition, but also to increase their day-to-day contact with the place and the landscape, providing knowledge, and thus improving people's relationship with the place, raising their love and respect for the country. People will be fascinated not only at the sightseeing spots, but also at the walking alleys on the ridges of the hills with open places for far outlooks. This contributes to the general psychological health, satisfaction and harmony in people.

The development of recreational potential also accepts the requirements of sustainable development of the area consisting of three pillars, economic (productive potential of the landscape), social (enhancing bond between people and the landscape) and environmental (protection of nature), and the requirements of protection of the landscape character and values of the area. The production potential of the landscape is enhanced by the proposed orchard and alleays of fruit trees, whose fruit can be locally processed and promoted by the local brand in the context of soft tourism (ecotourism). The ecological stability of the area is increased due to the completion of vegetation corresponding to the hydrologic biocorridor of the Torysa river, by adapting the part of the forest to recreational uses by more stable species composition and structure, and eventually by the proposed alleys increasing biodiversity on large grasslands. Last but not least, to protect the landscape and the values of the area, the proposal modifications revitalize some of the values as the planting of the appropriate vegetation in sacral areas and the revitalization of the existing alleys. A negative impact on the landscape could be the construction of the aquapark and residential houses on vulnerable slopes, thus it is recommended to regulate the construction, such as low-floor buildings and naturally landscaped surroundings with high trees softening the negative visual impact.

Conclusion

In the work, the recreational potential of the area was evaluated using Bina´s (2010) and Carbol´s (2010) method. The recreational potential of the cadastral area of Lipany is below average. Based on the analysis of the area, its values and problems were defined. The modifications of the area were proposed. The individual proposed elements and changes in the country do not only increase the recreational potential of the area but also act multifunctionally and increase landscape production potential, ecological stability, protect and revitalize landscape values and eliminate identified problems in the area. Subsequently, the recreational potential of the area is re-evaluated, taking into account proposed landscape modifications, which demonstrate an increase in the potential by one degree in both methodologies.

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Souhrn
Práce se zabývá katastrálním územím malého města Lipany na východním Slovensku, kde se spolu s termálním vrtem před pár lety objevila otázka zvyšování rekreačního potenciálu území spojeném s vybudováním akvaparku a dalších rekreačních zařízení. V práci byl vyhodnocen rekreační potenciál území podle metodiky Bina (2010) a podle metodiky Carbola (2010), rekreační potenciál katastrálního území Lipany je podprůměrný. Na základě provedených analýz území byly definovány jeho hodnoty i problémy a byl vytvořen návrh změn v území tak, aby jednotlivé navrhované prvky nejen zvyšovaly rekreační potenciál, ale zároveň i působily polyfunkčne a zvyšovali ekologickou stabilitu, produkční potenciál krajiny, chránili a revitalizovali hodnoty území a eliminovali identifikovány problémy v území. Znovu vyhodnocen rekreační potenciál území se zohledněním navrhovaných úprav krajiny dokazuje zvýšení potenciálu o jeden stupeň v obou metodikách.

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INFLUENCE OF SLOPE ON THE STABILITY OF THE BANK

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Abstract
The slope of the slope has a major influence on shore stability. On the research area - sand and gravel Hulín - several types of modifications are proposed. Gradient slope 1: 10, incline slope 1: 5, and 1: 2. Salix fluviatilis is planted on the slopes. We monitor their growth and stabilization. The article describes the state of the shore in the selected section in 2016 and in 2017.

Key words: reservoir, slope, water, bank, grass

Introduction

We can divide the reservoir stabilization:

1. Important influence inclination shore - Biotechnical ways of stabilization – combinations of technical and biological stabilization elements: fascine or fascine-gravel cylinders, woven fences, bands of rubble masonry with vegetation, etc. + groomed slope (Galas et al, 2013; Kotásková et al, 2013)

Stabilization methods of biological engineering – reinforcement by vegetation – mainly riparian stands of willow shrubs in the eulitoral zone, reed stands in the sublitoral zone, grass carpets, trees (Šlezingr, 2016; Šlezingr, Fialová, 2012).

- Vegetation reinforcement of banks nowadays mainly woody plants of genus *Salix* – shrub species, further *Alnus, Populus, Fraxinus, Quercus, Acer,* and others. Stands of woody plants need to be accompanied by a herbal layer, erosion protection grass carpet. (Kotásková et al, 2016; Zeleňáková et al, 2015)

2. Less influence of slope - Breakwaters – submerged, semi-submerged, and emerged breakwaters, permeable, impermeable, fixed, movable.
   Technical ways of bank stabilization – concrete or reinforced concrete retaining walls, stone ripraps, tiles, prefabricated reinforcements, gabion mats, etc.
   Longitudinal redirecting constructions (built along the banks)
   a longitudinal bar
   a longitudinal interrupted bar
   Transversal redirecting constructions (built perpendicular or slanting to the bank)
   spur dikes perpendicular to the bank
   spur dikes slanting to the bank
   Retaining walls of all kinds training walls – perpendicular, slanting – made of concrete, stone, gabions,sheet pile walls, piles, prefabricated blocks …

Materials and methods

The most commonly proposed slope is 1 : 1,5 to 1 : 3, especially 1:1,5 to 1: 2.

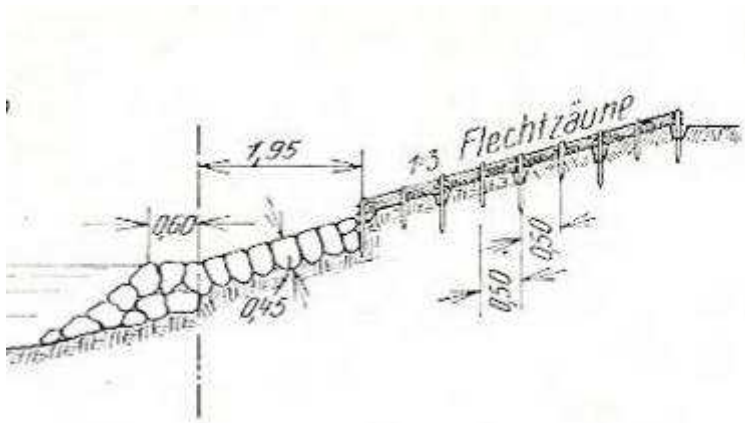

Fig. 1: Examples of suggestions from a professional publication Schoklitsch, A. Der Wasserbau (Springer WIEN 1930) [9]

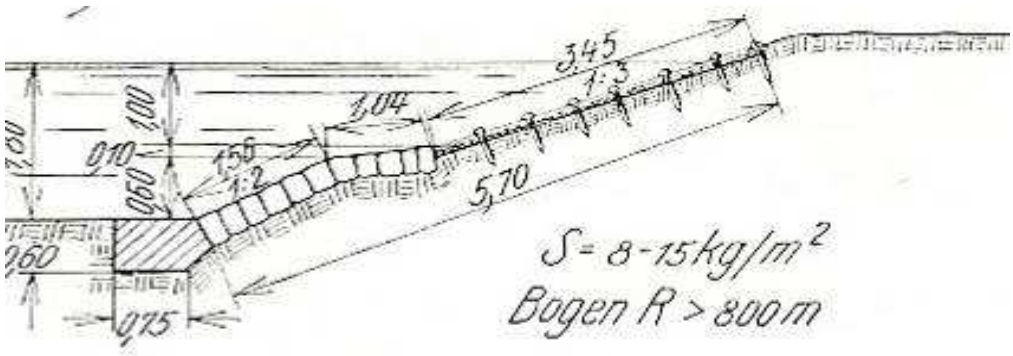

Fig. 2: Examples of suggestions from a professional publication Schoklitsch, A. Der Wasserbau (Springer WIEN 1930) (Schoklitsch, 1930)

In our case, we propose slope 1 : 10, 1 : 5, and 1 : 2 on one slope – see Fig. 3

Under the slope we design different types of heel fortifications – stone rockfill with a recovery, the combination of stone wood, litle fence of branches, single row, multi-row, cylindre sof the branches, etc.

Results

So far, the effects of stabilization are unknown. We closely follow developments (Pelikán et al, 2018; Šlezingr et al, 2010). Measurement of water level is done once a week. Unfortunately, the water level is low. Of course, this is good for the safety of the slope. From the standpoint of verifying the stabilization proposal, this is a problem.

Fig. 3: Slope 1 : 10, 1 : 5, and 1 : 2 – bank of reservoir Hulin
Phooto M.Šlezingr 2016

Conclusion

We have described one of the methods of stabilization. We are preparing further research areas - reinforcement by vegetation – mainly riparian stands of willow shrubs in the eulitoral zone, reed stands in the sublitoral zone, grass carpets, trees. Research on new areas will continue. Significantly involvement will also be students Ph.D. Today they are processed by two doctoral thesis on this topic.

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Souhrn
Vliv sklonu svahu na jeho stabilitu je zásadní, pokud nepočítáme s budováním některého z typů stabilizace. Svah ve sklonu větším než cca 1 : 1,5, se již při menším porušení (zatížení) může stát nestabilním a je nutno navrhnout a následně realizovat biotechnickou či technickou stabilizaci (případně jinou dle konkrétní situace). Návrh prezentovaný v předkládaném příspěvku se zabývá možností navrhnout úpravu svahu v několika sklonech. Nejníže k vodní hladině předpokládáme sklon 1 : 10, následuje 1 : 5 a 1 : 2 (1,7). Takto upravený břeh vytvoří jakousi „polovinu misky“. Vzhledem k nejníže položené sesvahované části, která vlastně vytvoří plážový břeh, bude třeba pouze minimální, případně žádné zvláště budované stabilizace paty.

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INSPIRE'S POTENTIAL AS ADDED VALUE FOR NATURAL AND ENVIRONMENTALLY SENSITIVE TOURISM DESTINATIONS' MANAGEMENT: RESEARCH NOTES FROM SLOVAKIA

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Abstract
Development of tourism activities and growth of tourism related industries comes hand in hand with a higher anthropogenic impact on destination's natural environment. Among other, the necessity of monitoring these impacts was acknowledged by the European Commission's 2013 pilot European Tourism Indicators System for sustainable destination management (hereinafter ETIS). The manuscript analyzes the possible advantages of European Union INSPIRE Directive's outcomes' use for destination management at LAU2 level, in correlation with the ETIS from the perspective of data access and further integration. The analysis was conducted on specific destinations of Kosice self-governing region, Slovakia. Results indicate that even if INSPIRE's scope is primarily on spatial data covering environmental topics, its outcomes may be a useful resource for building up basic natural and environmental relations of destinations that directly concern tourism's primary resources' preconditions. Furthermore, the majority of INSPIRE data may be integrated in to third party information systems and applications dealing with data driven destination management.

Key words: Data driven destination management, open geo data, ETIS, tourism impacts

Introduction

The „European Tourism Indicators System for sustainable destination management" (hereinafter ETIS) and the „INfrastructure for SPatial InfoRmation in Europe" (hereinafter INSPIRE) as initiatives aim to create a more sufficient way of accessing, processing and integrating data in a structural fashion. While the ETIS as a standardized template gives a solid methodological overview on basic tourism related impacts and relations, INSPIRE's outcomes, in terms of content and possible reusability, have the potential to widen ETIS's implementation in local destinations. The aim of the contribution is to provide a brief introductory analysis on INPIRE data's and tourism resources categorization compatibility with emphasis on the aims of the ETIS standard on examples from Slovakia.

Materials and methods

The necessity of open data as has been recognized officially as obligatory variable for European society's development (European Commission, 2011). The ETIS as a standard follows up the challenge aligned with measuring tourism and related activities' impact's on destinations' via set of 43 core indicators divided into 4 essential sections aimed at monitoring levels of destination management; economic value; social and cultural impact; and environmental impact (European Commission, 2013). The basic principle of the voluntary standard is the joint contribution of all stakeholders within destination management duties, responsibilities and decision-making. The system itself in terms of information cooperation emphasizes that the

collection of data would simply be a process of concentration of individual data sources at one place to create a detailed picture of the tourism industry in the destination (European Commission, 2013).
The INSPIRE „*aims to create a European spatial data infrastructure for the purposes of EU environmental and policies and policies or activities which may have an impact on the environment*" by enabling sharing of environmental spatial information mainly among public sector organizations (European Commission, 2017; European Commission, 2018). One of the newest outcomes of INSPIRE in Slovakia it the open Registry of spatial units (Ministry of Environment of the Slovak Republic, 2018).
Since both tourism resources and the ETIS are dependent from environmental data, the content of the Registry of spatial units' (hereinafter RPI) data collection has been reviewed and its content matched with tourism resources categorization (Fig. 1) and the ETIS's content.

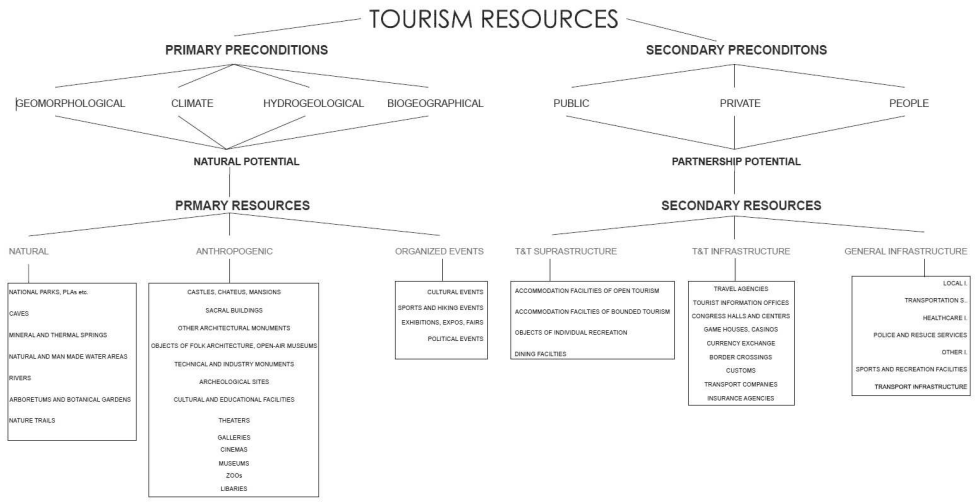

Fig. 2:Tourism resources' categorization (Sidor et al.,2017a)

Results
In terms of tourism destinations territories' spatial representation or modelling the RPI provides access to official administrative boundaries at LAU 2 level. More importantly RPI contains data which partially determine primary (e. g. protected areas and subjects of protection; data on rainfall, average temperatures and rainfall densities supporting monitoring of weather patterns; geological and hydrogeological conditions, geo hazards etc.) of a destination.
In terms of achieving a higher ETIS template dataset's complicity, RPI's data can provide support to enlisted sections of the destination basic Profile:

1. Destination Profile
    a. Location overview – transportation;
    b. Geography – size and principal physical characteristics, dominant habitats, level of biodiversity;
    c. Weather patterns – precipitation and temperatures;
    d. Population;

Tab. 1: Pairing ETIS criteria with INSPIRE themes containing relevant data (Source: European Commission, 2013; European Commission, 2018)

ETIS criteria section	INSPIRE theme
Transport Impact	• Transport networks
Climate change	• Atmospheric conditions • Meteorological geographical features
Sewage treatment	• Area management / restriction / regulation zones & reporting units
Solid waste management	• Area management / restriction / regulation zones & reporting units
Water management	• Hydrography
Energy usage	• Energy Resources
Landscape and Biodiversity Management	• Land cover • Area management / restriction / regulation zones & reporting units • Soil • Species distribution • Population distribution and demography • Protected sites • Production and industrial facilities • Natural risk zones

Discussion

Even though INSPIRE is not oriented primarily on tourism resources or destination management, more than 50 % of 1065 RPIs published services, data collections and data sets have a relation to tourism. RPI offers an XML open API for its Meta Data, thus browsing its content may be automated and even partially (in the case of open license data with no restrictions) integrated into to third party solutions. In many case data is downloadable, but some of the content with follow up criteria (old mining sites, mineral resources, bearings) are only provided as Web Map Services (Fig. 2).

Conclusion

With no doubt INSPIRE's outcome in the form of RPI may be beneficial for the ETIS's implementation as for data driven destination management. Data's integration into third party platforms and linking with other data is crucial for gaining more complex insights for decision making (Khouri et al., 2009; Khouri et al., 2011).

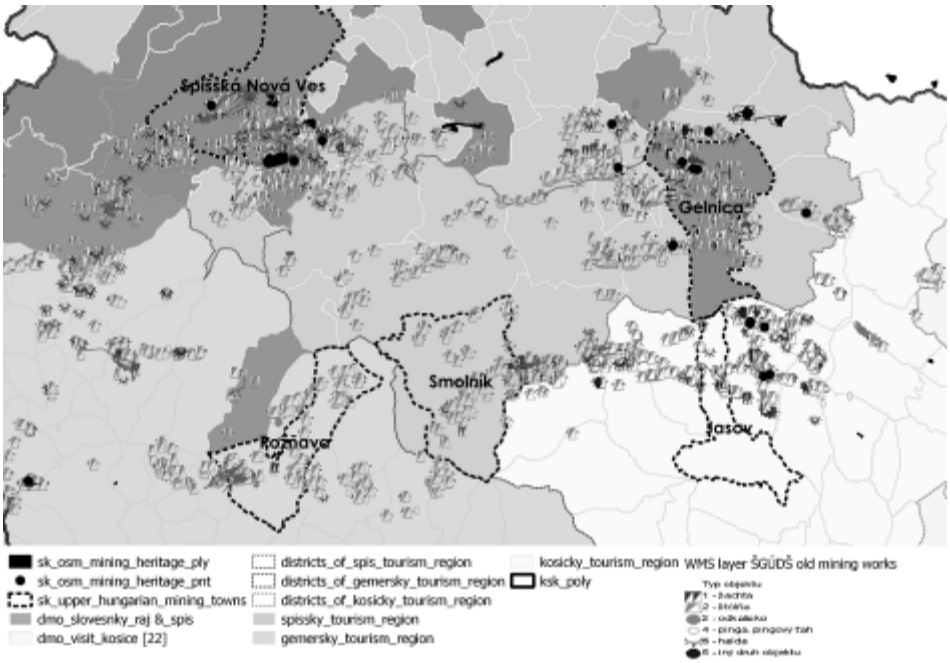

Fig. 3: Testing published services and data by the RPI (Sidor et al., 2017b)

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Souhrn
Rozvoj turistických aktivit a růst průmyslu souvisejících s cestovním ruchem jdou ruka v ruce s vyšším antropogenním dopadem na přirodné prostředí destinace. Potřeba monitorování těchto dopadů byla mimo jiné potvrzena pilotním Evropským systémem indikátorů cestovního ruchu 2013 pro udržitelnou správu destinací (dále jen ETIS). Příspěvek analyzuje možné výhody používání směrnice výsledky iniciativy INSPIRE pro řízení destinace na úrovni LAU2 v korelaci s ETIS z hlediska přístupu k datům a další integrace. Analýza byla provedena na konkrétních místech Košického samosprávného kraje na Slovensku. Výsledky ukazují, že i když je oblast působnosti INSPIRE primárně zaměřena na prostorová data pokrývající environmentální témata, její výsledky mohou být užitečným zdrojem pro budování základních přírodních a environmentálních vztahů destinací, které se přímo týkají předpokladů primárních zdrojů cestovního ruchu. Navíc většina údajů INSPIRE může být integrována do informačních systémů a aplikací třetích stran, které se zabývají řízením cílových dat.

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LANDSCAPE PROTECTION AND TOURIST VALORISATION OF THE CULTURAL AND NATURAL HERITAGE OF THE UNESCO SITE OF MATERA (ITALY)

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Abstract
The use of advanced technological tools may considerably support the protection of landscapes with high cultural and naturalistic value, since they allow the implementation of multidisciplinary information, which may reveal crucial for a sound management of sites representing an heritage of outstanding value. In the present paper, a special analysis has been focused on the UNESCO site of the City of Matera, located in the Basilicata region (Southern Italy), where some protected habitats (Natura2000 areas) still coexist with a considerable number of cultural sites, earning to this location the role of European Cultural Capital in 2019. Suitable conservation strategies, focused to preserve the natural and cultural landscape, which may be affected by increasing touristic flows, are then necessary. A Geographical Information System of Matera's tourist routes, starting from already existing ancient paths, was implemented to develop new public recreation activities without negatively affecting the surrounding landscape. A specific database was therefore designed for the Matera landscape, which has been implemented with the dual purpose to be a useful tool for planning a sound management of the landscape structures and, through the implementation of a Web-GIS, to create new opportunities for enjoying the urbanized territory in close contact with natural landscapes.

Key words: cultural landscapes, protected habitats, sustainable tourism, Geographical Information System, Matera.

Introduction

Landscape planning requires an integrated approach, due to the need to join the touristic valorisation with the preservation of naturalness. So, multidimensional and multidisciplinary analysis methodologies are needed (Antrop, 2000). Moreover, it is necessary to use different types of data (spatial and non-spatial) with different characteristics (from historical data to digital cartography) to evaluate, in an holistic way, every aspect concurring to shape the landscape (Statuto et al., 2017). The use of a Geographical Information Systems (GIS) is very helpful, since it allows several analysis suitable for tourism purposes. Indeed, there are many examples of application of a GIS to implement territorial marketing strategies (Albuquerque et al., 2017) or to valorise the sustainable development of rural tourism (Statuto et al., 2017). Furthermore, in sites which are highly sensitive to management issues, a GIS approach could support a decision-making process based on the dual objective of enhancing and protecting natural and cultural heritage (Berg, 2012; Xishihui Du et al., 2018). A GIS methodology may be applied to provide a useful tool to public decision-makers, to guarantee the integrity of the landscape and to select the best strategies for the valorisation of the rural territory (Statuto et al., 2013).
One the most complex examples in Europe of natural and cultural landscapes simultaneously present in the same location, which are currently suffering for an unsustainable increase in anthropic pressure resulting from a sudden growth of

tourism activities, is the UNESCO site of “Matera”. The City of Matera, located in the Basilicata region (Southern Italy), has been designated as an European Cultural Capital in 2019. It is the city of Italian art having in last seven years increased more (+152.4%) the volume of its visitors (Centro Studi Turistici, 2017). As well as the protection strategies, that can be implemented towards historical sites from environmental condition (Gizzi et al., 2016), the increase in the tourist flows is also determining several problems as: the depopulation of the typical "Sassi" dwellings in favour of commercial activities, that determines a loss of the cultural identity of these places; the overcrowding of naturally sensitive areas, with an high tourist interference which endangers the integrity of some habitats and species protected by European Commission. With the aim to provide a tool useful for the public decision-makers, able to manage these important issues, in the present paper a methodology for the implementation of suitable conservation strategies through a GIS is presented. The first step has been the realization of an inventory of resources and the creation of a database with new public recreation activities which don’t negatively affect the surrounding landscape. The second part of the paper concerns the creation of a Web-GIS aimed to satisfy people's needs, through an integrated platform with highly-visualized natural and interactive functionality (Chang et al., 2011).

Material and methods

The City of Matera (Fig. 1) is well-known for its extensive cave-dwelling area, the “Sassi”, a UNESCO World Heritage Site designated since 1993. The “Sassi” provide a stunning backdrop of stairways and narrow lanes, cave-houses carved out of the rock, rock churches with magnificent frescoes. Alongside the historical-cultural aspects, the Matera landscape is made up of relevant naturalistic elements: the Natural Historic Archaeological Park of “Rock Churches”; a Special Area of Conservation (SAC) as well as a Special Protection Area (SPA), both included in the UE network of protected sites (Natura 2000). All archaeological, cultural and naturalistic sites form an area with an extraordinary tourist appeal.

Fig. 1: The study area of the “Matera” UNESCO site

The first step has been to realize a spatial data collecting and processing the existing available open data concerning natural and cultural heritage. In this way, it has been possible to organize a common and updated database of this area, that can be the tool for all the following steps analysis. The sources consulted were: the

Basilicata Region data catalogue; some relevant “Natura2000” reports; the national/regional touristic and naturalistic databases; management plans; LIFE program data; Open Street map GIS database. The database has been standardized in the format, both in the topology and in the coordinate system. Data were aggregated for macro categories, so as to optimize the final results. A field research has been scheduled to collect necessary data which were not available. To each element of the database, a unique identification number (ID) has been finally assigned, so as to facilitate the subsequent phase of consultation, management and updating. In the second step, thanks to the use of historical cartography (Statuto et al., 2016), some ancient paths was identified, and the most interesting among them were chosen and modified in relation to the database previously created and the current land use. Subsequently, the different cultural sites along this path - excluding routes crossing areas which are fragile from a naturalistic point of view - were mutually inter-connected. The choice of the areas to be excluded was carried out on the basis of the breeding sites of some amphibians which are considered threatened in Europe (Picuno, 2017) and on the Sassi’s areas with the highest nesting concentration of *Falco naumanni* Fleischer hawk (IUCN, 2016). Finally, the main route and the secondary perspectives have been calibrated through the use of a specific QGIS plugin (Walking time), which allows to estimate the travel time (in minutes) and in reverse direction, along with a line depending on the slope and in accordance with the type of walking or walker. All operations were performed with the QGIS 2.18.13 software.

Results and Discussion

The first result coming from the implemented methodology has been an integrated database with geo-referenced tourism resources, environmental and landscape heritage of the city of Matera (Fig.2). This tool allows to have a flexible and exploitable management system for different objectives, going from the identification of environmental incompatibilities to the creation of new tourist activities. In this way it is possible to plan new paths modifying the old routes.

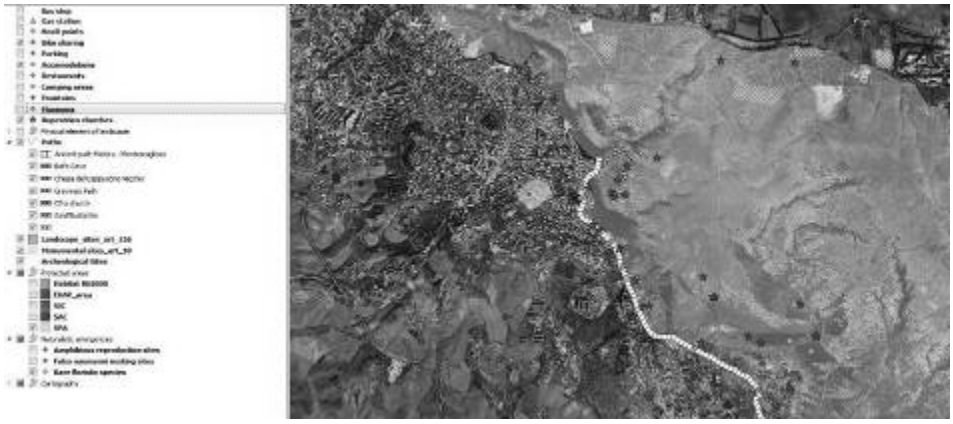

Fig. 2: Database of touristic resources, natural and cultural heritage of Matera

One of the paths is the old sheep-track “Matera-Montescaglioso”, that starts from Matera and ends at the Benedictine abbey of “St. Michael the Archangel” in the town of Montescaglioso (Fig.3).

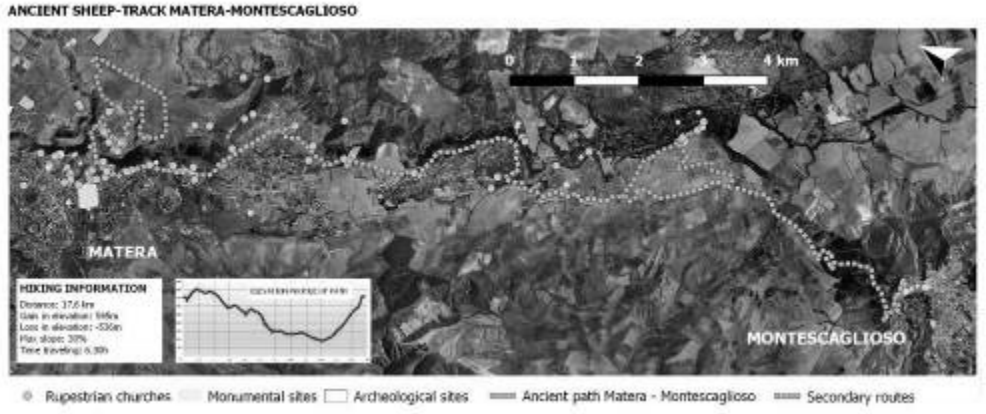

Fig. 3: Digitalization of old sheep-track Matera-Montescaglioso

Thanks to the data included in the GIS, it has been possible to associate this information with those useful for hiking purposes (slope, time travelling, elevation profile, etc.). In addition, the interoperability of modern GIS tools allows a rapid and effective implementation of products useful for the promotion of heritage, such as a Web-GIS. Starting from the main database, a demonstrative Web-GIS platform has been therefore created, and a navigable 3D system has been realized, so as to plan tourist activities more engaging and "immersive" (Fig.4).

Fig. 4: Screenshot of the created web-GIS

Conclusion

The development of digital and online geographic technologies has increased the opportunities to develop new applications for landscape management and marketing, from which the public decision-makers and tourists can benefit. The creation of these tools requires a phase of in-depth research of the territory, in order to create a system that is as complete as possible. Furthermore, it is essential that public administrations implement "open government" policies, finalised to have access to obtain high quantities of open data. It is essential, namely, that these

databases are dynamic and quickly updated through, for example, a shared system in which the different actors can have access to the data. The GIS tool allows in conclusion to plan with a good accuracy the tourist activities in a proper way, so supporting to find the right compromise between fruition and conservation of the landscape.

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Souhrn
V tomto článku byl využit potenciál nástrojů GIS pro implementaci metodiky umožňující jak valorizaci, tak i ochranu krajiny. Oblastí studia je místo UNESCO ve městě Matera, které se nachází v oblasti Basilicata (jižní Itálie), kde některá chráněná stanoviště (oblasti Natura 2000) stále existují společně se značným počtem kulturních památek. Analýza prvního kroku zahrnovala shromažďování a standardizaci údajů o přírodním a kulturním dědictví souvisejícím se zdroji cestovního ruchu. Realizace správné databáze je zásadní, protože představuje spojovací prvek mezi všemi aktéry, kteří se zabývají územním plánováním. Počínaje touto geodatabází, až po digitalizaci starých tras, je plánována nová trasa založená na zajímavostech a především mimo oblasti, které představují mimořádné zásahy do životního prostředí. Konečně, za účelem podpory a rozšíření oblasti byla vytvořena první verze Web-GISu.

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LANDSCAPE RECREATION AND BIOCLIMATOLOGY – HAND IN HAND

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Abstract

Urban and suburban climate research ranks highly as a current topic in recent climatology, largely due to the growing number of city inhabitants together with the significant effects of climatic conditions on their health and the risk of damages caused by extreme weather events. In the case of air temperature, some parts of the landscape (city centres, bare farmland, some agricultural crops) may be about several degrees centigrade warmer than typical rural recreation areas. The vegetation removing and unifying of areas with higher radiation balance increases temperature extremes and resulting biological stress and discomfort (also in the rural areas). In article used mapping expression of distribution of air temperature with using the ZABAGED layer is comprehensive, but generalized output with just orientation information value. Presented measurements, largely experimental, do not allow in present time quite explicitly draw conclusions from level of degree of difference of same types of active surface in urban and/or suburban landscape. It can be thought for example urbanized areas in inner city opposite suburban (villages). As well as it is not possible estimate differences of role of similar vegetation cover in inner city opposite open landscape (agricultural).

Key words: land use; land cover, urban heat island, suburban areas, temperature field

Introduction

The rate of urbanization is especially important for low- and middle-income countries, as 70% of the world population is forecasted to live in cities by 2050. Urban Heat Island (UHI) is a function of meteorological factors (air temperature, precipitation, solar radiation, cloud cover, air flow, evapotranspiration etc.) and the character of the city itself: the number and population density, topography, altitude, water bodies, land cover – built-up area, surface colour, distance between buildings, building heights, surface resistance, surface geometry of the city, "anthropogenic heat" of heating and industry, surface retention etc. (Oke, 1997). Often presented idea of the heat island as concentric isotherms with maximum temperature in the centre and gradual decrease towards the outskirts is greatly simplified. Especially warm bodies with the characteristics features (parking, industrial equipment, flat roofs, asphalt roads, etc.) are defined as "micro urban heat islands – MUHI" (Středa et al., 2011). Comparison of surface temperatures of materials represent widely used in urban area with temperatures measured at climatological stations allows estimation of microclimatic conditions of given locality during different weather situations. Individual localities vary each from other mostly by character of active

surface. Surface temperature markedly demonstrated in all cases of selected active surfaces differences according to day time. Very expressive differences of vegetation surface temperature were connected with the species and density. It was declared possibility of identification of hot/cold spots in urban and/or suburban landscape (Středová et al., 2015).
High air temperature causes intensive physical stress with negative impacts on health. One of the main risk factors is incidence of long-term period of high temperatures during the summer months, so-called heat waves (i.e. hot weather more days lasting period of summer heat during which the daily maximum air temperatures reaching 30°C or more). Frequency, intensity and duration of heat waves did not increase generally during the 20th century. But in the 21st century, especially in the second half, the situation will be altered dramatically. Wider impacts may include effects on the retail industry, ecosystem services and tourism (Střelcová et al., 2006). It was found that for heat waves in summer, mortality was strongly associated with the duration of the heat wave.
Landscape feature and its utilization are always to some extent determined by climatic conditions. On the other hand, the landscape structure affects the climate, withal the important climate influencing factor is also a human activity. Changing climatic conditions coupled with intensive farming systems, land use changes and massive urbanization threaten the quality of the environment. A significant positive thermoregulation effect of vegetation (including the disperse one) was proved in many times. The effect of "land cover" was also reflected in the humidity formation.

Materials and methods

Data source

Data of Czech Hydrometeorological Institute (CHMI)

- Localities (Nr. 7 and 8 in Fig. 1): CHMI climatological station „Hradec Králové Svobodné Dvory“ and „Nový Hradec Králové“ are the standard climatological stations with the monitoring at two meters above the grasslands.
- Data from to: 1961 - present
- Measurement step: 15 or 10 min
- Measured elements: air temperature (mean, maximum, minimum), air humidity, wind speed and direction, precipitation total, height of snow cover, sun shine duration.

Ad hoc monitoring – HOBO Pro sensors: The network of special purpose monitoring points (Nr. 1 to 6 in Fig. 1) was established in Hradec Králové and surroundings in 2011 to analyse the influence of surface properties (land cover and land use) and its horizontal variability on temperature and humidity conditions. Details, location and specification of measurement points and brief characteristics of the environment, see in Středa et al. (2014) and Středová et al. (2015). The sensors monitor the air temperature and air humidity in a wide variety of urban and suburban environments. The special purpose measuring by the sensors HOBO U23 Pro v2 Temperature/Relative Humidity Data Logger located in the radiation shield took a place at a height of two meters above ground. The measurement step at all stations was ten minutes.

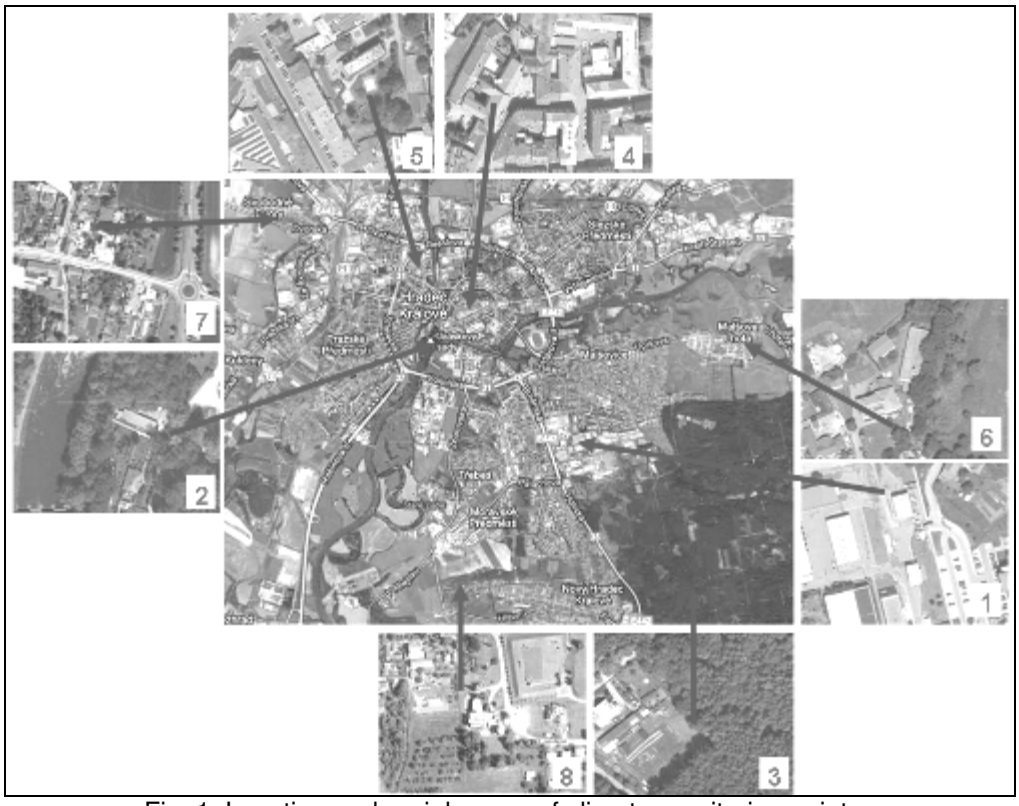

Fig. 1: Location and aerial snaps of climate monitoring points

Evaluated characteristics

Number of tropical (TD) and summer (SD) days and sum of temperature (TS) in core area of interest

- TD: maximum daily temperature exceeded 30°C
- SD: maximum daily temperature exceeded 25°C

Regionalization of temperature condition of extended area of interest:

- It was carried out by the use of:
  - ZABAGED land-use data
  - Air temperature data
  - GIS tools
- The goal: temperature stratification at 2 m height at model temperature of 30°C during diurnal part of the day.

Area of interest

Core area of interest: Hradec Králové town

Task: point evaluation of defined climatological characteristics for individual sites od ad hoc monitoring.

Extended area of interest: Hradec Králové region

Tasks: Regionalization of temperature conditions; Basic climatological characterisation (Tab. 1).

Tab. 1: Basic climatological characteristics of extended area

Annual characteristics	**1961-1990**	**2021-2050**	**2071-2100**
Mean annual air temperature (°C)	8.7	9.9	11.8
Mean annual precipitation total (mm)	600*	586	556
The hottest month	July (18°C)	August (22°C)	August (25°C)
The coldest month	January (-1.8°C)	January (-1.4°C)	January (0°C)
Number of days without precipitation	84	122	141

Results

TD and SD

Tab. 2 shows difference in number of SD. TD a TS at individual localities of urban and suburban monitoring.

Tab. 2: Climatic difference of area of interest

Nr of locality	7	8	4	5	2	1	3
SD	90	81	86	88	95	107	88
TD	40	39	98	38	33	68	45
TS (VI - IX)	8002	7879	8893	7955	7866	8534	7952

Regionalization of temperature conditions in Hradec Králové region

The relationship between air temperature at individual localities is expressed by conversion table (Tab. 3). It was created by regression analysis between temperature at reference station (CHMI – Nový Hradec) and other points of measurement.

Tab. 3: Air temperature at measurement points (°C) at model temperature of 30°C at reference station, diurnal part of the day

Reference station	3	1	2	5	4	6	7
30°C	29.8	32.5	28.9	30.1	33.3	30.1	30.2

Spatial expression and regionalization of point measurement of air temperature (Fig. 2) for was created by GIC and was based on Tab. 3 and ZABAGED land-use.

Conclusion

An influence of particular agricultural crops on climate is driven by complex relationship without chance of broader generalization. Thus, there could be a situation when canopy with intense transpiration (wheat, barley and rape in April and May, maize in June and July, etc.) shows even higher air-condition effect than wood or forest vegetation. Having sad that extrapolated temperatures significantly correlate with air and surface temperatures from control measurements. Even though the Fig. 1 represents generalised expression there are still clear temperature differences as an effect of type of active surface and land-use (artificial surfaces or cooling effect of vegetation or water bodies).

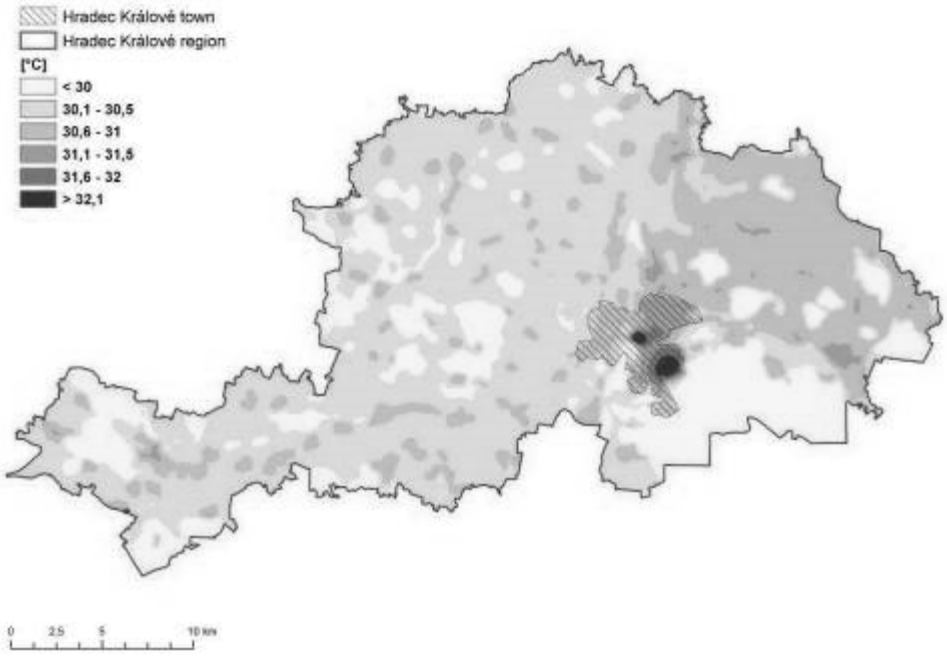

Fig. 2: Temperature map of extended area (Hradec Králové region)

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Souhrn
Prezentovaná klimatická měření ze zájmového území ORP Hradec Králové, interpolovaná do plochy s využitím údajů z geografického modelu území ZABAGED, nedovolují v současnosti zcela jednoznačně vyvodit závěry o tom. jaká je míra odlišnosti teploty stejného typu povrchu v městské a příměstské krajině. Jedná se například o zastavěné plochy ve vnitřním městě a v okolí. Stejně tak nelze posoudit případné rozdíly teploty v případě ploch se stejným typem vegetačního krytu ve vnitřním městě a v příměstské oblasti, v tomto případě venkovské a zemědělské krajině. I když se jedná o generalizované vyjádření plošného rozložení teplot na území města a okolí, jsou však zřejmé teplotní diference v závislosti na zástavbě a typu povrchu, respektive na ochlazovacím efektu vegetace nebo vodních ploch. V rovinatých územích je v rámci mezoklimatických studií možno vyloučit vliv nadmořské výšky, expozice a reliéfu na teplotní pole a akcentovat vlivy land use. V případě řešené oblasti ORP Hradec Králové je krajinou matricí zemědělská, resp. orná půda. V mapách teplotního pole je tato kategorie brána víceméně jednotně, nicméně z logiky věci je jasné, že její vliv na krajinu je determinován konkrétním land cover, a že tedy ani její teplotní režim nelze považovat za uniformní.

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LOCATION AND CONSTRUCTION OF WOODEN SHELTERS IN NATURE

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Abstract
People in nature are looking for a place to rest during recreation. On selected locations should be placed not only the bench to sit, but also suitable shelters. Shelters are popular mainly in case of sudden weather changes. At the same time, the roof construction of the shelter is a structural protection for wooden construction structures. This increases the life of wooden elements. The paper focuses on the requirements for location and permission of such small buildings. It describes, where and under what circumstances the shelters can be built. In addition, suitable structures for different dimensions are recommended.

Key words: rest areas, location of small buildings, wooden structures

Introduction

In the Czech Republic huge amount of people use nature for recreation. Recreation can be short and long-term. For example, as stated Šišák (Sisak et al., 2016), more than 85 % of inhabitants of the Czech Republic visit forests annually. The main purposes for visiting forest include: short-time relaxation (42 % of visits), picking berries (29 % of visits) and leisure activities (12 %), there of especially hunting, sport, getting to know nature and nature protection activities. There is an opinion in the subconscious of people that recreational effectiveness of forests consists particularly in their technical facilities (Pelikan et al, 2018, Hrůza, 2013). Therefore, there are specific places and areas where small buildings show not only their meaning but are also in demand. It is possible to regulate human activities by shelters or only benches and information boards. Many holiday-makers occurs only in these localities. It has its advantages. This creates certain resting zones, which are necessary mainly for game but also for preservation of certain herbaceous vegetation etc.

Materials and methods

For the nature environment, therefore we shall plan wooden constructions or stonework in particular. Indispensable advantage of wood consists in its effect on the environment. From the ecological point of view wood is quite trouble-free material with minimum energy costs for harvesting, processing and waste. Wood is elastic, durable and light material with easy workability and machinability being relatively well connectable and easily handled. Naturally, it shows also several disadvantages such as its combustibility, considerable hygroscopicity and absorbability and relatively low decay and insect resistance.

Basic supporting structure and members can be designed from round timber, square-cut timber or pole timber. The structure must be reinforced both in longitudinal and transverse direction to resist effects of weather particularly wind. In the longitudinal direction, the reinforcement is ensured by bands. horizontal members are most stressed.

Due to closed surface, manually barked round timber and pole timber with undisturbed surface layers shows much better resistance to biotic and abiotic effects as compared with sawn timber. Under outdoor conditions, it requires similarly as

other wood certain forms of weather protection. The protection can be carried out either structurally or chemically. Structural protection should be preferred because chemical protection brings about not only high costs in application but also subsequent ecological problems. Buildings in general and thus also small buildings can be either permanent or temporary; in the given case, small buildings are considered to be temporary. These buildings do not need a plan, but it is necessary to start from a layout and static calculation. Through static calculations, the reliability must be assessed of a construction to bear up against a loading which can occur during the construction use. Construction calculations are carried out taking into consideration all unfavourable combinations of loading. These combinations are to be determined with respect to the actual possibility of the parallel effect of particular types of load. In our case, we take account of the basic combination of permanent and incidental short-term loading.

Results

The small buildings must be sensitively integrated into the given landscape. It is recommended to situate the small recreation buildings near forest glades or right on them and on places with good vista of the landscape. In planning and situating these facilities we have to keep in mind that these constructions are an aesthetic complement which should not function as a disturbing factor. In terms of building permits, it is often erroneously presented that the shelter in the landscape is not actually a building and does not require any permission. From the definition of the term structure from the Building Act, it follows that structure means all structure works arising by building or assembly technology, regardless of their construction, construction products, materials and structures, purpose of use or duration. A temporary structure is a structure that has a limited duration of construction by the building office. A construction product is also considered to be a structure.

The shelter is a roofed structure without peripheral vertical structures (some or all) and is designed for a particular purpose. In the sense of ČSN 73 4055 - Calculation of Enclosed Area of Building Structures - it is a semi-covered building, whose construction not only creates a carrier system, but also partially enclose it. The object then approaches the building by its character because it has a roof and optionally some of the wall constructions.

From 1 January 2018, an amendment to the Building Act entered into force. Most changes in the law lead to a simplification of the building permit process and to reduce the administrative burden on the developer. One of the most significant changes brought by this amendment is the extension of the list of buildings that do not require a decision on location of the structure, planning consent or the notification of the structure. In practice, this means that some buildings can be realized without building control and without the awareness of building office. However, the builder must follow the applicable laws, and not just the building law in their actions. Obligations and restrictions stemming from the Nature and Landscape Protection Act were not affected by the amendment of the building act. In most cases, the builder is mainly limited by obligation not to disturb the landscape, which assesses the nature conservation office.

Location of the structure

Decision on location of the structure or the planning consent do not require, among other things, single-storey structure up to 25 m^2 of built-up areas and up to 5 meters high, which are located on the grounds of a family house or building for family recreation, if they are placed at a distance away from the common land boundary at

least 2 m. It also includes structure for forest management and exercise of hunting rights up to 30 m^2 of built-up area and 4 meters of height and one-storey public shelters up to 40 m^2 of built-up area and 4 meters of height (eg bus stops, etc.). This means that these structures can be realized without the awareness of the building office. However, it must not disturb the landscape. Other shelters require a decision on location of the structure (§ 79 of the Building Act) or the planning consent (§ 96 of the Building Act) or a public contract (§ 78a of the Building Act). According to § 76 par. 1 of the Building Act, structures or installations can only be placed on planning permission or planning consent, unless the law provides otherwise. The same applies to their change or change of land use and to protecting important interests in the area. In the planning permission proceedings, the building office assesses whether the intention of the applicant is in accordance with the objectives and tasks of the town and country planning, especially with the character of the territory, with the requirements for protection of the architectural and urban values of the territory ... "according to § 90 b). (Act No. 225/2017 Coll)
The Nature and Landscape Protection Act is more specific in the specification of landscape protection requirements. It is dedicated to § 12 of Act no. 114/1992 Coll., on nature and landscape protection. "...It is necessary to have the consent of the nature conservation office for siting and permitting of constructions, as well as other activities that could reduce or change the landscape character…"
Most small structures probably will not interfere with the landscape. Problematic may be constructions in the open landscape, in a view-exposed location - on hills and slopes or in landscaped sites.

Discussion
Although wood is today often replaced with other materials, it is undoubtedly an appropriate material for the construction of shelters. It is a highly aesthetic and natural material which will not stand out in a natural landscape. Thanks to the up-to-date technologies it is possible to design wooden shelters for small, medium but also large spans. However, to ensure their long life and proper function, constructional protection of wood and chemical surface treatment are necessary.
Constructional measures start with the construction design which should prevent water penetration into wood and allow for fast waste discharge as much as possible. If a partial or a complete covering of the main construction elements is not possible, unnecessary or inadequate content of wood moisture can be prevented by means of a suitable solution of individual constructional details.
• In covered constructions, the roof sloping, the type of roofing and sufficient overhangs are important.
• It is necessary to prevent standing water on wood surfaces – attention must be devoted to gradients and areas of cross sections, sloping surfaces are more suitable than horizontal ones. If there are horizontal wooden elements, it is necessary to guarantee water runoff by at minimum a natural fall and to leave gaps between the elements so that water could flow off and air could circulate between them.
• It is advisable to avoid openings, cuts, etc. where water could gather. Wooden elements can be also protected against rain and water by sheeting, or easily replaceable wooden planks.
• The geometry of the constructions and the details of joints have to be designed so that water does not gather in the joints, or so that water can evaporate thanks to air circulation.
• In order the wooden construction not to be in contact with soil subject to effects of sprayed precipitation water, soil moisture and snowmelt we plan to fix the structure

on steel shoes or special metal anchors which have to be embedded in concrete bed slabs (Havířová, 2006).

Conclusion

In places interesting from tourist aspects, it is suitable to design rest places with simple structures creating integrated part of the landscape. Thus, using particularly natural materials not only for supporting structures is supposed. Light wooden framework and log structures completed by stone structures predominate.

To increase the life span of wooden structures in the exterior environment it is necessary to pay attention particularly to the protection of constructions. Since roofing creates a general aesthetic effect the selection of roofing should be carefully assessed.

Other shelters require a decision on location of the structure or the planning consent, or a public contract and it is necessary to have the consent of the nature conservation office.

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Souhrn

Na turisticky zajímavých místech v lesích je vhodné navrhovat odpočinková místa s přístřešky. Tyto stavby nepotřebují projekt, ale je nutné vycházet z nákresu a statického výpočtu. Statickým výpočtem musí být posouzena spolehlivost konstrukce, ta musí odolávat zatížení, které se vyskytne během jejího používání. Stavby přístřešků nepotřebují stavební povolení, ani ohlášení stavebnímu úřadu, je však nutné řešit z hlediska územního řízení a ochrany krajiny. Stavba musí být v souladu s územním plánem a nesmí narušovat krajinný ráz.

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MANAGEMENT OF RIPARIAN VEGETATION IN TOURIST-EXPOSED LOCATIONS

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Abstract
The paper deals with basic principles of management and maintenance of riparian vegetation, with emphasis to localities under tourist, sports or recreation pressure. Riparian vegetation maintenance and/or its planting are generally carried out by the administrators of the individual watercourses, or other entities connected with the land ownership. All these actions are driven by strict rules of the Czech legislation. Specialized institutions are also important especially in terms of methodology. The management of individual localities is always very specific, which makes the application of the strict rules difficult, and requires close cooperation between owners, nature protection institutions, administrative bodies of watercourses and riparian vegetation specialists (certified arborists). The paper states the most common types of riparian vegetation maintenance in terms of operational safety, which the administrators or owners of the watercourses consider as the main priority. It is the owner who takes the material and criminal responsibility for the damage to the health and property, which can be caused by the trees in bad condition. Therefore proper management of the riparian vegetation maintenance is absolutely crucial especially at places with a greater concentration of people.

Key words: arboriculture, tree pruning and cutting, planting trees, operational safety of trees

Introduction

Nowadays people spend much time in the countryside, where they do various sports and tourist activities. This trend leads to an increasing number of people and their activities near the watercourses and reservoirs widely used for recreation especially during the summer. That includes activities such as swimming, boat trips, water sports, cycle trails, hiking trails, etc. The river landscape occupies 10% of the Czech Republic area, and it is the most important type of landscape (Křivánek, 2014).
The vast majority of watercourses and reservoirs, which are burdened by a frequent occurrence of people, have a riparian vegetation in their vicinity. The owner of the riparian tree vegetation is responsible for the operational safety, the mechanical stability of the trees and the damage to the property and the health of people (Vait, Franková, 2013). The watercourse administrators are also obliged to maintain the vegetation, especially Povodí state enterprises and Czech Forestry Commission, who are often also the owners.
From the water administrators' point of view the riparian vegetation mainly has the hydrological-water management function (such as flood control). Their recreational, ecological, economic, energetic and commercial functions are also important (Lampartová, Schneider, 2016). Recreational and commercial functions are mainly used at the places with widespread land use potential (i.e. reservoirs, water sports camps and especially cycling trails). There was a boom in construction of cycle paths and trails along the watercourses close to riparian vegetation due to the financial support of the state in the 90´s (Vait, Franková, 2013) - Fig. 1

Fig. 1: Marking of tree cutting – locality Vykytná

Riparian and associating vegetation fulfil a number of irreplaceable functions in relation to the watercourse and its surroundings (Šlezingr, 1996). Such vegetation along with the watercourse creates the basic bio-corridors, and together other landscape elements form „skeleton of ecological stability" (Zuna, Soukup, 2007).

Materials and methods

The management of vegetation maintenance is a complex and extensive process. It is necessary to follow two basic legal regulations: Act 254/2001 Coll. on water, which defines the rights and obligations of watercourse administrators and riparian vegetation and their maintenance; and Act No. 114/1992 Coll., on the Nature and Landscape Protection. This act defines the legislative processes necessary for implementation of vegetation interventions such as notification of tree cutting, tree cutting authorization, tree protection, substitute planting or general species protection. The definition of significant landscape components and rules for intervention into them are also very important, because each watercourse is defined as „significant landscape component".

From the methodology point of view there are several crucial standards for the riparian planting and maintenance: the Standards of Nature and Landscape Care published under the auspices of Nature Conservation Agency of the Czech Republic, namely standard A02 001: 2013 Trees Planting (Kolařík et al., 2013) and A02 002: 2015 Cut of Trees (Kolařík et al., 2015). These two methodological outputs clearly define the individual types and techniques of interventions realized mainly on trees growing outside forest in order to preserve their aesthetic, ecological and other functions and to ensure their operational safety and the content of the operations carried out during the planting of trees in the extra-forest environment.

Results

All riparian stands growing in the vicinity of exposed tourist sites are potentially dangerous. An inspection by a qualified person on behalf on the authority of the owner or a land manager should reveal common defects and risk factors. In some cases expert reports by dendrology specialists can be processed.

The most common biotic defects and hazards include fungal diseases and various kinds of rot attacking whole trees, various plant parasites (mistletoe) or animal parasites (wood borer species) as well as aggressive invasive species, which disrupt the viability of original tree species by allelopathy (e.g. *Robinia pseudacacia*). Abiotic defects are caused by external factors such as storms, lightning, unstable subsoil and anthropogenic activity (construction work, unprofessional treatment or

vandalism). These factors together then leads to damage and dying of trees, which are often exposed to risk phenomena such as tree drying, broken branches or broken branches suspended in the crown, dangerous tree tilt, etc. All these phenomena must then be within the management of the exposed localities regularly and consistently removed.
In order to preserve the original vegetation as much as possible, various standard arborist interventions are the most common form of maintenance. Such interventions are usually provided by certified arborists using tree-climbing techniques applying different types of cuts. Cuts according to the "Tree Cutting Standard", by which dry and damaged branches, and rot-infected parts of trees are removed are the most commonly used tree cuts. From the operational safety point of view the following interventions are most often used: health tree cut (Figure 2); safety tree cut (Figure 3); circumferential reduction; head tree cut (almost exclusively used for willows).


Fig. 2: Health cut


Fig. 3: Safety cut

If a tree is already so damaged that stabilization by arboristic interventions is not possible, it is necessary to cut it down. There is a division according to the urgency of the intervention: a) a system and planned step - trees are felled within an appropriate extra-growing season; (b) an emergency situation - there is an immediate risk and the removal must be carried out without undue delay. Subsequently, it is appropriate to supplement the cleared stand by substituting autochthonous tree species and to ensure their subsequent care while respecting the Tree Planning Standard.

Discussion

The riparian and accompanying stands fulfil a number of irreplaceable functions in relation to the watercourse and its surroundings: anti-erosion, anti-deflationary, protective, aesthetic, productive, and mainly recreational. They also influence self-purifying capacity of watercourse and provide a refuge for fauna (Šlezingr 1996). Nevertheless, it is always necessary to clearly define a prior function. Maintenance planning differs, e.g. around water reservoir or a relatively inaccessible watercourse, where all interventions are mainly subordinated to the water management function (e.g. maintaining the river flow). Operating safety at such locality is not a priority, and stands can be left to relatively natural development. On the contrary, the

management has to be subordinated to operational safety with minimization of health and property risks near reservoirs used for swimming, or in the vicinity of cycle paths or waterways. The importance of river flows and urban vegetation has increased in the last 20 years. Localities around rivers should be used in multifunctional way (Lampartová, Schneider, 2016).
According to Černý (2013) the cooperation with landowners, municipalities, etc. regarding the care of riparian stands in urban areas, close to cottage settlements and camps would be good (Figure 4). Unfortunately, this is not always possible in practice. Firstly, due to often unclear ownership conditions, and often due to the reluctance of adjacent properties owners to solve these risk situations. Velebil (2013) states, that there is still a lack of clear instructions how to proceed with riparian vegetation management in a particular area. Nevertheless, it is important to say that each locality is specific, and it is rationally impossible to create. On the other hand, with the development of the various standards on nature and landscape management, a generally accepted consensus can now be found.

Fig. 4: Planting of riparian vegetation in Svitávka locality

Conclusion

The riparian vegetation of watercourses and reservoirs is one of the important parts of territorial ecological stability system, ecologically balanced landscape and one of the forms of scattered greenery growing outside forest complexes. The watercourse along with healthy riparian vegetation is a unique filtering and air conditioning element, which can be particularly perceived in the cities. Higher and larger stands or generally less stable and rot sensitive species of trees (willows) or trees infected by non-native invasive pathogens near watercourses should be controlled more consistently, especially in areas with high people occurrence.
From the long-term point of view it is desirable to maintain riparian vegetation regularly, especially at places with a larger number of people, so that they can fully fulfill their aesthetic and ecological function. Assuming compliance with the Standards of nature and landscape management, it is possible to implement the management systematically and, as far as possible, uniformly throughout the whole river basin.

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Souhrn
V České republice jsou volnočasové aktivity v přírodě, obzvláště pak u vody, velmi populární. V okolí vodních ploch se obvykle vyskytují doprovodné břehové porosty, které jsou mnohdy svým špatným zdravotním stavem a zhoršenou stabilitou nebezpečné. Právě zvýšený pohyb osob na těchto lokalitách je velkým rizikem pro správce, resp. majitele pozemků, kteří mají hmotnou a trestní odpovědnost za škody způsobené jeho majetkem. Z tohoto pak logicky vyplývají určité povinnosti, které musí vlastník ve vztahu k údržbě dřevin dodržovat. Činnosti, které legislativa a metodické publikace umožňují či doporučují při managementu břehových porostů lze shrnout do dvou kategorií: zásahy obnovní, čili odstranění a obnova porostu (nebo jeho části) – tj. kácení a případně následná náhradní výsadba. Tyto zásahy je vhodnější aplikovat tam, kde je porost v natolik špatném stavu, že jeho zajištění již není možné nebo je ekonomicky mimořádně nehospodárné. Druhým typem jsou pak speciální udržovací zásahy na stromech formou jednotlivých typů řezů (zdravotní, bezpečnostní, redukční atp.). Řezy mají pak za cíl zachovat dřeviny na lokalitě s tím, že je zajištěna jejich stabilita a provozní bezpečnost na poměrně dlouhou dobu. Výhoda těchto činností je především v zachování původní struktury často velmi starého a ekologicky cenného porostu.

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MAPPING OF HABITATS FOR PURPOSES OF ECOSYSTEM SERVICES ASSESSMENT AT LOCAL LEVEL

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Abstract
Ecosystem services are a new concept for assessing a value of ecosystems and biodiversity for the human society. They represent a base for the current policy of nature and biodiversity conservation. Identification of ecosystem services through their mapping or modelling is an inevitable step for their later assessment. The paper deals with mapping of habitats and their importance for assessment of ecosystem services. The argument is that healthy ecosystems possess a full potential of ecosystem functions. Biodiversity, in particular plant species diversity, has an important role in structuring habitats, ecosystems and landscapes, which is necessary for many species, and hence ecosystem services to exist. An ecosystem can provide potentially several services that may affect each other in a positive or negative way. The paper proposes the integration of mapping and assessment results with another information to develop a methodical proposal for assessing mutual relations of ecosystem services and for research into the role of biodiversity and a state of habitat on delivery of ecosystem services.

Key words: biodiversity, habitat, vegetation, ecosystem services

Introduction

Ecosystem services represent a new concept of assessing an importance of ecosystems and biodiversity for the human society. They constitute a basis for the current policy of nature conservation and biodiversity. Despite the fact that human life is dependent on the nature and natural processes, only selected parts of the nature have a determined value and are included in the economic balance as natural resources (forestry, agricultural land, water resources). These are mainly natural resources or products as tradable commodities, but a large part of the benefits we receive from the nature have not been reviewed yet, and therefore are considered as economic externalities. For this reason, the cost of protection and care for the nature are often seen as superfluous or even an obstacle to development. In order to achieve the sustainable development by preventing from over-exploitation of the nature the theory of ecosystem services has been developed (Loreau et. al. 2001, MA 2005, Bateman et al. 2010, TEEB 2010, EEA 2011, Naumann et al. 2011). The concept of ecosystem services allows the integration of the value and the benefits of ecosystems into the economic analysis. It is a combination of natural and economic sciences and the development of so-called Green economy. Apart from the economic point of view, the role of eco-science in this process is to provide information on ecosystems as closely as possible. Knowing their structure and functions enable to evaluate the range of services that these ecosystems provide and can potentially provide to society. Mapping of ecosystems and their services is currently a highly topical global issue that is also reflected in the EnvironmentPolicy of the European Union and its Member States. European Biodiversity Strategy by 2020 (COM (2011) 224) in its target 2 directly requires Member States to present their concept of mapping ecosystems and their services by 2014, followed by an implementation phase in the coming years. This

mapping will be done both at European and national levels (MAES et al. 2013). The first globally accepted classification of ecosystem services was the Millennium Ecosystem Assessment (MEA) in 2005. This divides ecosystem services into production, regulatory and cultural services. Current classifications (TEEB 2010, CICES 2013) took over and improved this division. Besides the production services such as food production and biomass, which are traditionally valued and perceived as the commodities in national accounts, it currently emphasizes the mapping and quantification of ecosystem services regulating natural processes that are potentially dangerous or damaging values directly. These natural processes are accelerated due to unsustainable land use. They regulate the flow of materials, water and air masses due to extreme meteorological phenomena (soil erosion, protection against storms, flood protection). Favorable status of ecosystems is extremely important because healthy ecosystems will help to develop the full potential of ecosystem services.

Background of mapping and assessment of ecosystems and their services

The scientific community has attempted to directly reflect the importance of the nature and its ecosystems for human populations and the sustainability of life in the biosphere in the last three decades, but to a larger extend only in the last decade. In the past quarter of the past century had been developed many experimental methods of evaluation of non-market benefits of the nature which most authors measured by detecting the willingness of individuals to pay for a certain quality of the environment, nature and landscape or willingness to accept (compensation) for deterioration. However, these methods have a series of system limitations which have marginalized the social interest so far. The need for valuation of functions and services of ecosystems is more urgent because environmental aspects of areas are not taken into account in the economic decisions in the form of specific prices. Therefore, there are sought ways and methods that have expressed also prices of functions and services of ecosystems and thus allow the necessary comparisons between the economic and environmental costs and benefits in the use of the nature. This involves expressing the benefits and costs of a natural and near-natural ecosystems, which often competes with the standard economic use of the land ("the development of area") with completely non-natural construction, compaction of surfaces and displacement of water in land (Seják et al., 2010). Seják et al. (2010) states that the concept of ecosystem functions is based solely on the natural sciences, while the services that ecosystems provide human society already intervene in the human sciences. Current understanding of ecosystem services was introduced through the work of Costanza et al. (1997). Due to to report on ecosystem assessments (MEA, 2005) has been accepted and widely publicized approach using the term "ecosystem services". The established routine evaluation of ecosystem services can be, despite many problems, promoting their conservation (or limiting degradation). Most methods of evaluation is based on the derivation of environmental values, depending on the preferences of households and companies. These can be divided into methods derived from the market value (manifested preferences expressed by prices or travel expenses or costs that are avoided) and direct survey methods (set preferences) based on the willingness to pay or accept. In the Czech Republic was developed the method of assessing habitats (Seják et al., 2010) as the first systemic method of assessing environmental aspects of the nature and landscape. The monograph Čaboun et al. (2010) is dedicated to ecosystem services in the Slovak forests. A guide has been developed for rapid assessment of ecosystem services in protected areas in the Carpathians entering

the WWF (Bucur & Strobel, 2011). According to this guide it was later developed basic guide focused on Slovakia (Považan & Kadlečík, 2014).
Ecosystem services can be mapped by deductive or inductive methods. The inductive approaches ("bottom-up") based on the knowledge of ecosystems that occur in the surveyed country, their localization and areal occurrence or dispersion in the area (Eliáš, 2013).
The inductive method comprises the following steps (Eliáš, 2014):

1. identification of ecosystems according to plant communities or habitats,
2. evaluation of incidence and prevalence of ecosystems in the area ("mapping"),
3. analysis of ecological and social functions of ecosystems according to the biodiversity of vegetation,
4. analysis of the use of ecosystem functions (vegetation) - identification of ecosystem services.

Importance of the valuation issue is demonstrated by the fact that this topic area forms the largest group of papers published in the context of the ecosystem services framework. Key messages that are emerging from this growing body of work are:
a) It is essential to distinguish benefits and values clearly, because different groups may hold different values or perspectives on benefits. While the capacity of ecosystems to deliver benefits to people may be constant, the values we attach to may also change over time.
b) While economic valuation is the most widespread method used to compare people's perspectives on benefits, there is a growing interest in non-monetary techniques.
c) While the range of valuation methods available has grown in number and sophistication, there is still a need to improve the robustness of techniques, especially those relying on stated preference approaches and benefit transfer approaches (Haines-Young & Potschin, 2009).

Why is important to map habitats for assessment of ecosystem services?
Biodiversity research contributes significantly to the knowledge and assessment of the functioning of ecosystems and ecosystem services (Eliáš, 2011). Haines-Young & Potschin (2009) claim that there is a considerable body of evidence to suggest that biodiversity and ecosystem functioning are closely linked:
a) particular combinations of species may have a complementary or synergistic effect on their patterns of resource use which can increase average rates of productivity and nutrient retention;
b) vulnerability of communities to invasion by alien species is influenced by species composition and under similar environmental conditions, generally increases as species richness falls; and,
c) ecosystems' subject to disturbance can be stabilised, if they contain species with traits that enable them to respond differently to changes in environmental conditions.
However, quantitative relationship between biodiversity and ecosystem structure, processes and services is underresearched (De Groot et al. 2010) and therefore we focused on habitat mapping.
The process of mapping and assessment of ecosystem services at the local level, comprises the following steps:

1. Mapping of ecosystems (habitats) within the investigated area through field research, classification of ecosystems to habitat.

2. Identification of species composition and abundance of species through phytocenological entries in permanent grasslands as well as in non-forest woody vegetation.
3. Evaluation of ecosystems (through comparison current structure with optimal one or by the presence bioindicating species, or by other information).
4. Identification of delivery of ecosystem services in the area of interest (identification of selected production, regulatory and cultural ecosystem services by mapping and modelling in the GIS.
5. Evaluation of ecosystem services - quantification of provided ecosystem services by biophysical valuation.

Integration of mapping ecosystems to assessment of ecosystem services

Mapped ecosystems should be classified by habitat classification by Stanová & Valachovič (2002). In the case of forest habitats a data from management plans for forests can be taken over. Species composition and abundance of species through phytocenological entries in permanent grasslands as well as in non-forest woody vegetation should be identified. Data concerning species composition of forests can be used from the management plans for forests. For statistical evaluation programs we propose to use STATISTICA and CANOCO. Next, the conditions of ecosystems can be assesed through comparison the current structure with the optimal one. The assessment of ecosystems should also include information about their disruption of available data on the quality of the components of the environment from the spatial data by SEA (Slovak Environmental Agency) and SHMI (Slovak Hydrometeorological Institute). The next step is to identify the supply of ecosystem services. For the interpretation of potential of ecosystems for ecosystem services we suggest to build on the work Maes et al. (2011 and 2013) and the classification CICES (2013). Information on the relevance of particular plant communities reflect the potential for the use as ecosystem services. Based on the results of the evaluation of vegetation it is possible to determine the production ecosystem services (i.e. their potential) and also their biophysical value. On the basis of identifying the species composition of the vegetation by phytosociological research methods we suggest to use ecological and socio-economic assessment of vegetation (Jurko, 1990) for production properties as phytomass production, forage and honey, potential supply of medicinal herbs, the gene pool and also significance in the context of environmental protection. For comparison of production services we suggest to use models as SIBYLA (Fabrika & Pretzsch, 2011), CGMS (Nováková et al., 2010 http://mars.jrc.ec.europa.eu), or also the BPEJ (Džatko & Ilavská 2005). There is also possibility to evaluate the potential of habitats to provide ecosystem services in the future, based on assessment of their current status and presumed management or structural changes in vegetation.

Aims

Process of mapping and assessment of ecosystem services at the local level, comprises following steps:

1. Mapping of ecosystems (habitats) within the investigated area through field research andclassification of ecosystems to habitat,
2. Identification of species composition and abundance of species through phytosociological entries in the permanent grasslands as well as in the non-forest woody vegetation,

3. Evaluation of ecosystems (through comparison of the current structure with the optimal one or by the presence bioindicating species, or by other information),
4. Identification of ecosystem services delivery in the area of interest (identification of selected production, regulatory and cultural ecosystem services by mapping and/or modelling in the GIS,
5. Evaluation of ecosystem services – a quantification of the provided ecosystem services by their biophysical valuation.

Objectives of the presented work are the first three steps of the procedure.

Methodology of mapping habitats

Within the VEGA project no. 1/0186/14 "Evaluation of Ecosystem Services at National, Regional and Local Levels" the Zvolenská kotlina basin was our area of interest. A more detailed selection of grasslenad (originally sxtracted from Corine Land Cover 2006) for mapping was made using GIS based on specified criteria. Narrowing the selection of localities for mapping was based on a number of criteria to rule out differences between localities due to a different situation. The first criterion was the geological base-volcanic substrate, the slope 0-15°, the south, southwest and west aspect. For the comparability of habitats in the later assessment of ecosystem services, we focused on the type of habitat that prevailed among the localities meeting these criteria. Based on the above criteria, 15 localities with the same habitat type (mesophile pastures) were selected. The area of selected localities ranges from 1.6 ha to 15.8 ha. The habitat mapping was realized in July 2016. Species composition of vegetation and number of species on permanent grassland were identified. For each area, a list of all plant species recorded at the site was created. Names of the taxons are listed by the List of Lower and Higher Plants of Slovakia (Marhold et Hindák 1997). All species and their coverage in the Tansley's scale (Tansley et Chip 1926), were recorded during a one-time transition ("zigzag" system), at each locality for which field forms were filled. Tansley's coverage options are: 1 = less than 1%, 2 = 1% to 50%, and 3 = more than 50%. Subsequently, the mapped ecosystems were classified into habitats according to the classification of habitats in the sense of Stanová and Valachovič (2002). In the mapped habitats, it was followed the methodology of habitat mapping (Šeffer et al., 2002). Then the state of ecosystems was assessed. The quality of the biotope was assessed on the basis of an expert estimate. For each of the three categories of habitat quality ("good", "poor", "bad"), it was determined its percentage of the total area of the habitat. For each locality, GPS coordinates were recorded in the WGS-84 coordinate system. Floor coverage - percentage coverage of tree (E3), shrubs (E2), herbaceous (E1) and moss (E0) floor from the total area of the mapped habitat was recorded. All the activities on each of the mapped areas were also recorded. Names of activities and threats that are presently or potentially occurring on the area are listed according to the Natura 2000 habitat monitoring methodology. The intensity of the impact of the activity on the High / Medium / Low degree were also evaluated and recorded the percentage of the area under the influence of the activity. In assessing of habitat management (in % of total habitat area) their percentage of the total habitat area for both types of habitat management ("appropriate", "inappropriate") was determined. The prospects for each mapped site were also evaluated. For each of the three categories of prospects for the mapped habitat ("good", "not good", "poor"), their percentage of the total area of the habitat was determined.

Results

Based on the results of field mapping of ecosystems, habitat and management status assessments, as well as the coverage of activity levels together with their impact on each site, the mapped localities can be divided into three groups:

1. Localities with good habitat quality on their entire area without negative phenomena. This category includes localities no. 3, 4, 5, 6, 7, 9, 10, 13, and 15. The quality of the habitat on the localities is good within their entire area, management is also suitable for the whole area. Activities held on localities are mowing and grazing and occur flatly on 90% - 100% of the site area. The intensity of the impact of activities on the habitat is medium. Coverage of E1 is between 90% and 100%; E0, E2 and E3 are not present on all localities with the exception of locality no. 11, where E2 had a presence of 1%.

2. Localities with good habitat quality and low occurrence of negative phenomena. The localities no. 5 and no. 12 belong to this category. Good habitat quality at these localities ranges from 85% to 95%. Activities taking place at locality no. 5 are mowing and grazing of medium intensity and occur flatly over 95% - 100% of the area. Management of the locality is suitable for 95% of the area. Stomping and overuse occurs on 5% of the area, otherwise there is no disturbance or succession. Presence of E1 floor is 100%, E0, E2, and E3 are not present. Site management at locality no. 12 is suitable for 70% of the area. Presence of floor E1 is 95%, E3 occupies 1%. E0 and E2 are not present. Activities taking place at the site are mowing and grazing cattle, which occur at 70% of the locality. These activities are with medium intensity. Furthermore, successive processes of medium intensity occur on the area at 15% of the locality. Non-managed is 15% of the area, but no visible successive changes have occurred yet.

3. Localities with a partially good habitat quality. This category includes sites no. 1, 2, 8 and 14. From 60 to 70% of the area of these localities is characterized by the good quality of habitat. Activities taking place at the site no. 1 are grazing (95% of the area), stomping and overuse (5% area), waste incineration and solid waste (2% of the area), low-intensity succession grids (10% area), medium-intensity succession gates (5% area) and medium intensity erosion on 10% of the area. Management of the locality is suitable for 80% of the area. The quality of the habitat is at 60% good, 30% poor and at 10% bad. Presence of the E1 is 90%, E2 5% and E3 5%. The E0 is not present. The quality of the habitat at locality no. 2 is at 60% good, 30% unsuitable and at 10% poor. Habitat management is suitable for 60% of the area, 40% is inappropriate. On-site activities include unintentional grazing on 50% of the area, intensive grazing on 30% of the area with high intensity, succession with low intensity on 20% area and succession with a high intensity of 20%. The presence of E1 is 85%, E2 15%. E0 and E3 are not present. The quality of the habitat at locality no. 8 is at 70% good, 15% poor and 15% bad. Activities taking place on the site are mowing on 80% of the area, intensive grazing to 80% of the area and scaring and over-use on 5% of the area. This is an intensive pasture between the fields near the team. Some parts are weeded. The occurrence of species such as *Artemisia vulgaris* or *Urtica dioica* points to a higher nitrogen content on the locality. The management of the habitat on the locality is suitable for 70% of the area. Coverage of E1 is 95%, E2 2%, and E3 3%. E0 is not present. The quality of the habitat at locality no. 14 is at 70% good on the area, at 30% unsuitable. Habitat management can be marked as suitable at 70% of the area. Activities taking place at the locality are sheep grazing (at 70% of the area) with medium intensity, intensive grazing by mixed cattle to 30% with a high impact intensity and mowing on 60% of the medium intensity area. There are no deformities or successive gaps on the area and is

intensively used. However, abandoned meadows, which are partially wooded by *Pinus sylvestris*, occasionally grazed and can serve as refugium for species that could not be used on the intensively utilized area, are present near the area.

Conclusion

Mapping of ecosystems and their species composition and structure is an important part of the assessment of ecosystem services. Information on vegetation and its structure can be linked to information on the occurrence of bioindication species such as molluscs, which have a high information value in assessing the state of the environment in the context of landscape research and for bioindication (Šteffek et al. 2008). Several studies also show that high bioindication of the importance of ants for the assessment of ecological processes in agrarian and urban land (Gomez et al. 2003 Dahms et al. 2005, Ottonetti et al. 2006). By joining results of our habitat mapping and knowledge of the incidence bioindication animal species, it can be obtained the necessary information to determine the state of the habitat. The state of habitat plays an important role in the evaluation of ecosystem services. Knowledge of the condition of the habitat enables to study the impact of the quality of habitat and species composition to provide ecosystem services.

Our task within the VEGA project was to map ecosystems (habitats) in the area of interest through field research, classification of ecosystems into habitats according to habitat classification by Stanová and Valachovič (2002). The species composition of vegetation and the number of species were identified on permanent grassland. Subsequently, the state of ecosystems was assessed by expert estimation. The submitted work forms the basis for the subsequent identification of provided ecosystem services as well as the assessment of the impact of the favorable status of the habitat on the level of provided services. The next step, building on the mapping and assessment of the habitats, is an assessment of selected production services. All provided and quantified services (which should be classified into categories for this purpose) can be synthesized in the form of superposition of maps displaying the spatial distribution and size of the service. This makes it possible to link the results of mapping of habitats and production services they provide with the results of the evaluation of other services. This step can be used for research into interactions between ecosystem services. The synthesis of maps allows you to create an overview of the services provided and also between habitats (with the state) and the services provided. Based on the resulting maps it can be measured which services are supported or ruled out and examine the effect of habitat conservation status on specific services.

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Souhrn
Mapování ekosystémů a jejich služeb je v současnosti vysoce aktuální celosvětovou tématem, která se odráží v environmentální politice Evropské unie a jejích členských států. Kromě ekonomického hlediska, úkolem ekologicky orientovaných věd je v tomto procesu poskytnout co nejvěrněji informace o ekosystémech. Mapování ekosystémů a jejich druhového složení a struktury je důležitou součástí hodnocení ekosystémových služeb. Poznání jejich struktury a funkcí umožní následně zhodnotit nabídku služeb, které tyto ekosystémy pro společnost zajišťují nebo mohou potenciálně zajišťovat. Příznivý stav ekosystémů je mimořádně důležitý,

protože zdravé ekosystémy umožňují rozvinout plný potenciál ekosystémových služeb. Výzkum biodiverzity významně přispívá k poznání a hodnocení fungování ekosystémů a jejich ekosystémových služeb (Eliáš, 2011). Podle Haines-Young a Potschin (2009) existuje značné množství důkazů o tom, že biodiverzita a fungování ekosystémů jsou úzce spojeny.

Cíli předkládané práce jsou zmapování ekosystémů (stanovišť) v zájmovém území, kterým byla Zvolenská kotlina, prostřednictvím terénního průzkumu, identifikace druhového složení vegetace a početnosti druhů na trvalých travních porostech, zatřídění ekosystémů do stanovišť podle klasifikace biotopů od Stanová a Valachovič (2002) a zhodnocení stavu stanovišť v zájmovém území, jako podklad pro následné hodnocení ekosystémových služeb. Při mapování stanovišť jsme postupovali podle metodiky mapování biotopů (Šeffer et al. 2002). Následně jsme zhodnotili stav ekosystémů expertním odhadem. Na základě průzkumu vegetace jsme zjistili, že mapovány ekosystémy (mezofilní pastviny) spadají do podzväzu Polygalo-Cynosurenion Jurko 1974- květnaté horčinkovo-hřebínkové pastviny. V rámci 15 mapovaných lokalit podzväzu Polygalo-Cynosurenion Jurko 1974- jsme celkově identifikovali 141 taxonů.

Na základě výsledků terénního mapování ekosystémů, hodnocení stavu stanovišť a managementu jakož i zjištěné pokryvu etáží a aktivit spolu s hodnocením jejich vlivu na každou lokalitu, můžeme mapovány lokality rozdělit do tří skupin:

1. Lokality s dobrou kvalitou biotopu na celé své ploše bez negativních jevů. Do této kategorie patří lokality číslo 3, 4, 5, 6, 7, 9, 10, 13, 15. Kvalita stanoviště na uvedených lokalitách je dobrá v rámci celé jejich rozlohy, management lokalit je také vhodný na celé ploše.
2. Lokality s dobrou kvalitou biotopu a malým výskytem negativních jevů. Do této kategorie můžeme zařadit lokality číslo 5 a číslo 12. Dobrá kvalita stanoviště na uvedených lokalitách se pohybuje mezi 85% - 95%.
3. Lokality s částečně dobrou kvalitou biotopu. Do uvedené kategorie spadají lokality č. 1, 2, 8 a 14. Na 60 až 70% rozlohy uvedených lokalit se vyskytují kvalitou dobré biotopy.

Předkládaná práce tvoří základ pro následnou identifikaci poskytovaných služeb ekosystému jakož i zkoumání vlivu příznivého stavu biotopu na úroveň poskytovaných služeb. Informace o významnosti jednotlivých rostlinných společenství vyjadřují potenciál pro využití jako ekosystémové služby. Na základě výsledků hodnocení vegetace bude možné určit poskytované produkční ekosystémové služby (resp. Jejich potenciál) a také jejich biofyzikální ohodnotit.

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MÍCHOVA SKÁLA ROCK - REALIZATION OF THE OPEN COUNTRY VIEWS

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Abstract
On the locality Michova skala rock located in the Vysočina Region approximately 5 km northwest from Řásná village optimization of necessary forest removing to ensure the views from the Míchova skála rock top forward to attractive country points in immediate surrounding (Roštejn castle, Javořice hill, Velký pařezitý rybník pond and Horní Mrzatec pond) was carried out. The optimization was conducted by combination of the aerial snapping (using own dron) and GIS analyses in the space of the software QGIS. By the optimization the digital model of vegetation surface (received from own aerial snaps) and proposed view fields necessary in minimum to ensure the view to mentioned country dominants were compared. The areas of forest or particular tree which represent the visible barriers were identified on the intersection of these layers. These areas or trees were proposed to remove finally.

Key words: recreational optimization, country view**,** conflict of forest management and public recreation, Míchova skála rock

Introduction

The article presents results received from the research focused on the recreational optimization of Michova skala rock where the conflict of the usage requirements of the forest management of surrounding forests and recreation purposes occurred. The matter of mentioned conflict laid between the requirement of the progressive forest management on the site coming from forest management authority and the requirement of public recreants to ensure the country views targeted to the important local country dominants. With using the dron and aerial snapping and GIS optimization of the area of forest stands that should be minimally cut mentioned problem have been solved.

Materials and methods

Locality of presented study is the Nature Monument Michova skala rock, the sandstone rock on the top of the hill (773 m a. s. l.) named the same and surrounding forests (about 20 hectares). The locality is situated in the central part of the Czech Republic, Vysočina Region, about 5 km northwest from the Řásná village (see Fig. 1).

The methodology of the study consists of the steps as follows:

1. Field work - terrain recognizing, ensuring the view points, overflying the locality by the dron and taking the aerial snaps
2. Data analyses by the QGIS software with using the module Viewshed Analysis

Selected view points were finally localized on the northwest and southeast tops of the Michova skala (see Fig. 2) with the main aim to keep or renew the view fields targeted to the chosen country dominants: Roštejn castle, Javořice hill and the water body of Velký pařezitý and Horní Mrzatec ponds (see Fig. 1).

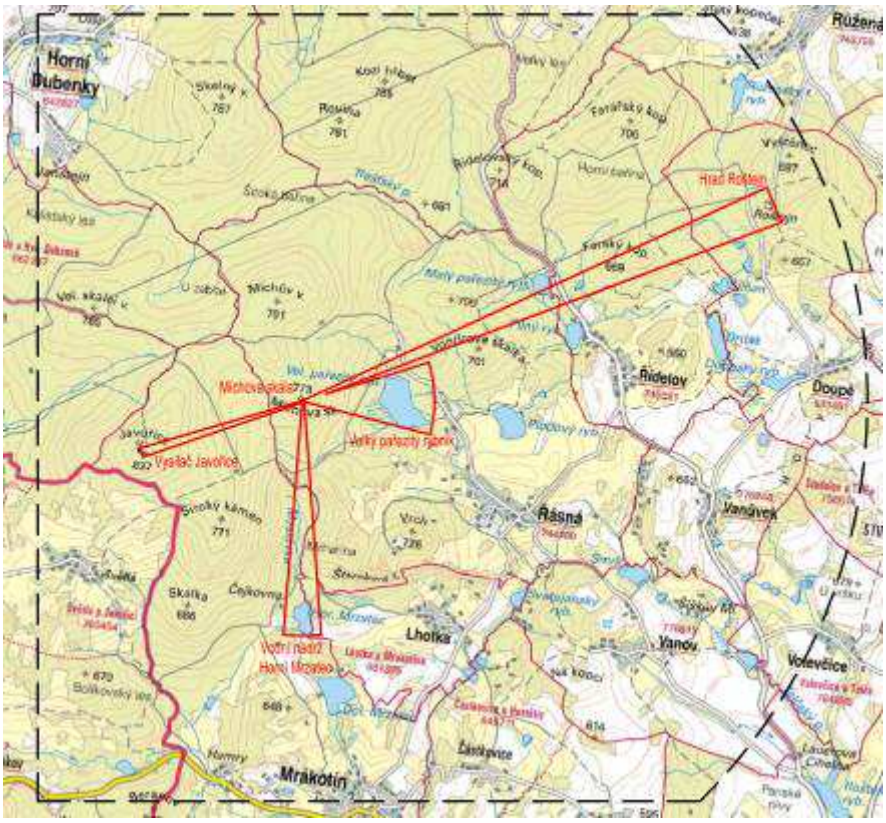

Fig. 1: Study area with highlighted required country view directions

Fig. 2: Míchova skála rock – view points

Perimeter of supposed measures in the forests was approximated on the base of field work, publically available height and positional data by ČUZK (Czech State

Administration of Land Surveying and Cadastre) and assumed height of the forest stands within the locality (aprox. 35 m).
The aerial snapping the locality by dron equiped by special camera system and cametra as well was conducted on the area aproximatelly 20 ha. All the data analyses were elaborated within the space of QGIS software with using the module Viewshed Analysis. This tool enables to determine visible surface, horizon, depth under the visible horizon or to create nets of visibility among the point groups.

Results
Continual digital model of the locality surface including the vegetation surface with pixel size 0.15 m was elaborated from the discrete data set (see Fig. 3).

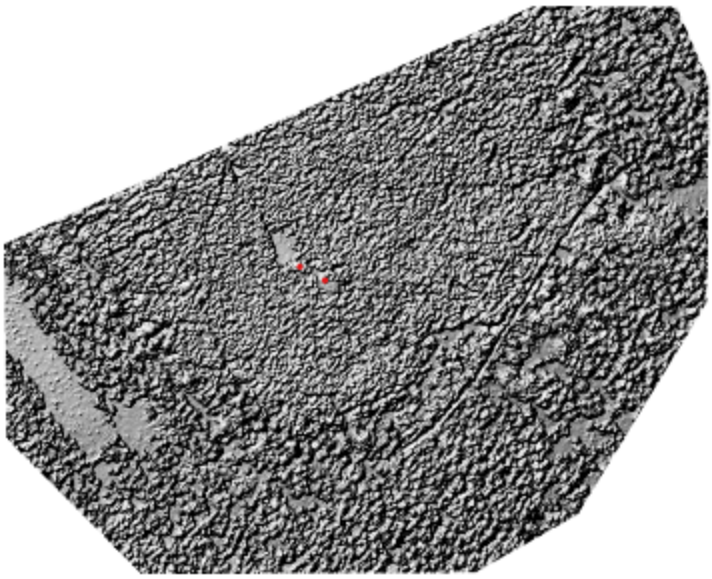

Fig. 3: Digital model of the locality surface including the surface of the vegetation and morphological structures (shadowing relief)

Altitudes (in m a. s. l.) of the view points and visual targets (chosen country dominants) were derived from the model (see Tab. 1)

Tab. 1: Derived altitudes

View point / country dominant	**Altitude (m a. s. l.)**
Míchova skála NW top	782.6
Míchova skála SE top	782.2
Roštejn castle	678.0
Javořice hill	837.0
Velký pařezitý rybník pond	677.0
Horní Mrzatec pond	606.0

Altitude level of the viewpoints used in the final optimization was calculated as the altitude of the rock tops shown in the table 1 plus 0.7 m, approximate height of the eyes level of the sitting adult:

NW top: 782.6 + 0.7 = **783.3 m a. s. l.**
SE top: 782.2 + 0.7 = **782.9 m a. s. l.**

Determination of trees and parts of the forest that should be cut to ensure proper view in a future was done then using the intersection view between digital model of surface and the surface of view fields. The features coming from the intersection mean in fact the trees or group of trees which represent visual barrier (see Fig. 4).

Fig. 4: Detail of intersection between the surface of the view fields and the digital model of the surface

Final contours of the trees or group of trees was elaborated on the base of the intersection of the layers mentioned above in the space of software QGIS using the manual vectorization method (see Fig. 5).

Discussion and conclusion

Using the methods and obtaining the results mentioned above finally the view field forward to Velký pařezitý pond and a few trees and group of trees were proposed to remove (cut). Comparing their localizations with the data of current Forest Management Plan (forest alignment map and plan of the measures in particular forest stands) the number of trees and volumes within particular measures were found out then.

However the optimal visible area forward to Velký pažezitý pond includes whole the area of the view field its clear cutting means disproportional management measure and would cause to the forest total destruction in the future. Due to this fact just two corridors were proposed to open the view forward to Velký pařezitý pond. These corridors are planned to be 10 m broad and 140 and 190 m long and there is the expectation of suitable ensuring the views to the surface of the pond when will be opened. Realization of the corridors will present the clearing of the area 0.33 ha removing 690 trees and the total volume of this systematic measure will reach approximately 36.5 m^3. As for the particular trees and tree groups, the measure will be realized individually with precise marking of each tree. Because the measure will be situated irregularly within the forest stands its final area is not possible to

calculate. Nevertheless, it is possible to state that 175 individuals in total volume 176 m^3 will be cut finally.

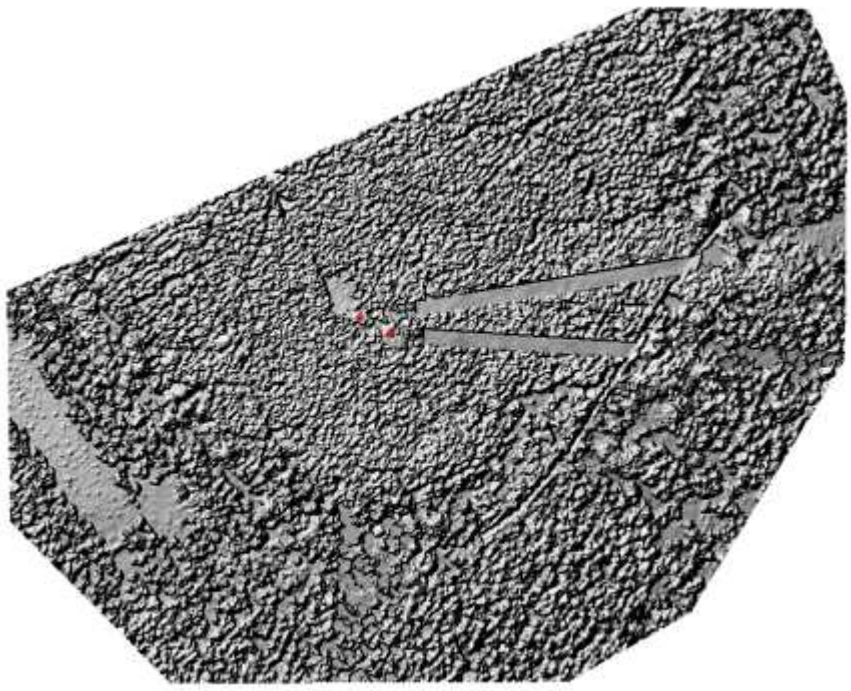

Fig. 5: Digital model of surface with the proposal of the forest measures - cut trees and group of trees (shadowing relief)

References

Basic map CR 1:50 000
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Altitudes 3D contour lines – maps 23-41-16, 23-41-17, 23-41-21, 23-41-22
Digital model of relief CR 5th generation (DMR 5G) – map Třešť 5-3
Forest Management Plan

Acknowledgement

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Souhrn

Na lokalitě Míchova skála nacházející se v kraji Vysočina přibližně 5 km severozápadně od obce Řásná byla provedena optimalizace nutného odstranění lesa za účelem zajištění výhledů z vrcholu Míchovy skály na atraktivní místa v bezprostředním okolí (hrad Roštejn, vrchol Javořice, Velký pařezitý rybník a rybník Horní Mrzatec). Optimalizace byla realizována kombinací náletu lokality za pomocí bezpilotního letounu a jejím osnímkováním sérií leteckých snímků a následným vyhodnocením dat v prostředí programu QGIS. Optimalizací byl porovnáván digitální model povrchu vegetace lokality (získaný z vlastního snímkování) a předpokládaná rozhledová pole nutná k zajištění výhledu na zmíněné krajinné dominanty. Na

průsečíku těchto vrstev byly identifikovány plochy lesa či jednotlivé stromy, které představují výhledovou překážku. Tyto byly následně navrženy k odstranění.

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NICARAGUA: FOREST PROTECTION AND DEFORESTATION

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Abstract
Deforestation and forest fragmentation are belong to the main components of global change and both contribute to the rapid decline of the tropical forest area with significant impact for the functioning of ecosystems and the protection of biodiversity. Deforestation is directly linked to species extinction, loss of ecosystem functions, increased CO2 emissions and other greenhouse gases, and changes in the structure and quality of aquatic ecosystem biotopes. Deforestation not only reduces the forest area but also changes the landscape configuration. Fragmentation increases the isolation of habitats and increases the edge effect. One of the main environmental problems of Nicaragua at this time is deforestation and fragmentation of forest stands. This problem is caused by an uncontrollable expansion of extensive livestock farming, unsustainable agriculture and population growth. The reason is that the Nicaraguan economy is directly dependent on agriculture and cattle farming. Another reason is the impact of climate change, when the entire Central American region is affected by a 3-year period of extreme drought caused by the climate phenomenon of El Niño. Last but not least, the share of illegal logging is also contributing to deforestation. Between 1990 and 2000, Nicaragua lost an average of 99,900 hectares of forest per year, which stand for a loss of 1,53% per year. Overall, between 1990 and 2005, Nicaragua lost 20.6% of the forest area or around 1 349 000 hectares.

Key words: deforestation, Nicaragua, forest fragmentation, Central America, agriculture

Overview of geography

This chapter briefly describes the geography of the state of Nicaragua.
Nicaragua can be divided into three geographical areas:

- The Pacific Lowlands are located in the western part of Nicaragua,
- Central area,
- Atlantic lowlands located on the eastern side of the state.

Compared to areas around the Atlantic ocean, that are rich in biodiversity, the Pacific Lowland of Nicaragua and the Central area are lined with volcanoes, between which we find the largest mountain ranges in Nicaragua. More specifically, the northern central area is the home of the Bosowas Biosphere Reserve with the beautiful Isabella mountain chain. It is a region rich for the species and also a home to indigenous Mayangn and Miskit residents.

Causes of deforestation

Nicaragua currently has a forest area of 7.9 million hectares, but gradually loses 1% of the forest per year or 150,000 km2 per year. As seen in Table 1 of Mongabay

International News, the forest area in 2005 was 42.74% of the country, but after just five years, the area fell to 26%.

Tab. 1: Statistic of forestation in Nicaragua

Nicaragua: Forest Cover, 2005	
Total Land Area (ha)	12,140,000
Total Forest Area (ha)	5,189,000
Percent Forest Cover	42.74%
Primary Forest Cover (ha)	1,849,000
Primary Forest, % total forest	35.63%
Primary Forest, % total land	15.23%
Other wooded land (ha)	1,022,000

Nicaragua: Forest Cover, 2010	
Total Land Area (1000 square kilometers)	12140
Total Forest Area (1000 ha)	3114
Percent Forest Cover	26
Primary Forest Cover (1000 ha)	1179
Primary Forest, % total forest	38
Other wooded land (1000 ha)	2219
Percent other wooded land	18

Source: *Mongabay. "*Statistics: Nicaragua." *Forest Data: Deforestation Rates and Related Forestry Figures*. Mongabay, n.d. Web. 18 Nov. 2015.

Nicaragua is being a home for the greatest tropical rainforest in the eestern Hemisphere outside of Amazon but its landscape beauty and biodiversity are being damaged by companies, which are seeking and upgrading their economic opportunities. These economic opportunities escalated during the debt crisis in the 1980s. In order to repay foreign debt, Nicaragua has increased its agricultural and timber production at the expense of the forestry sector.
At the same time, in regard of keeping up with the world's demand for a large amount of fruit, many corporations have searched for extensive land to increase the area of the necessary plantations. Corporations have the opportunity to buy and take up land from local small farmers in this country and set up farm systems without changing the crops that quickly deplete the soil from their nutrients. Besides agriculture, the negative impacts of deforestation and intensive logging have its roots in the 1990s, at a time when the government has made it easier for enterprises to access land in tropical forests for timber harvesting. This led to the destruction of 21% of the forest cover between 1990 and 2005. In 1998, the president carried onto execution a five-year law that banned the timber of cedar and mahogany. However, this law was not very effective because many large companies found gaps in the law, or did not observe it. It is estimated that about 50% of all wood comes from this illegal logging.

Effects of deforestation on indigenous communities
Local deforestation effects can be observed on events such as Hurricane Mitch and Hurricane Felix, which directly affect indigenous peoples near forests. In 2007, Hurricane Felix caused more damage than was originally predicted. It has damaged some of 1.2 million acres of forest in the northern Autonomous Region. Here it is to be noted that indigenous communities such as Miskito and Mayangna are directly dependent on preserving tropical forests for their further survival. Forests are the primary source of food and the shelter of these communities.
Due to the high importance of tropical forests for the domestic community, they have been pushing for organizations representing populations such as the Department of

the Environment and Natural Resources to reduce the level of corporation deforestation. The objective of the entities was to include forests from a certain country into national legislation, with the emphasis on preventing illegal exploitation by "colonists". However, attempts to stop the colonists had minimal effect. These efforts have always been hampered by the economic ambitions of large corporations and by the Nicaraguan government itself. Even this, through many failures, it has had an impact on the emergence of a new law that was enforced in 2002. This law was primarily favoured by indigenous peoples and their needs. Complying with this amendment has already had a slight positive impact in terms of reducing the level of deforestation in the countryside.

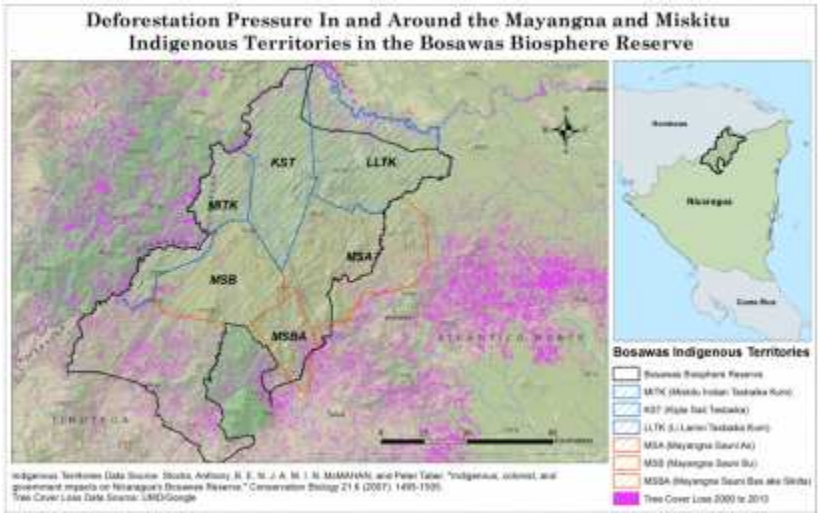

Fig. 1: Comparation of deforestation in the areas of Nicaragua
Source: Mongabay. “Tropical Rainforests: Deforestation Rates Tables and Charts.” Mongabay, n.d. Web. 18 Nov. 2015.

Figure 1 shows that areas that were not backed up and registered by the government had a much higher degree of deforestation than areas that were identified and supported.

Efforts of deforestation preventing

The major part of the guilt of high deforestation in Nicaragua is borne by large corporations. The government said in 2006 that it had protected the illegal exploitation of these corporations. However, this protection did not have a major effect on reducing the level of deforestation. In order to cope with this unstable situation, Daniel Ortega supported the Army in 2007 for helping the environment staff. His efforts, however, were applied only to large public corporations, not to private enterprises that continued the illegal exploitation.

Other measures have been used to support the fight against deforestation and global warming in Nicaragua to reduce carbon emissions. As deforestation increases the greenhouse gas emissions (about 15%), companies try to replace it with a carbon trading system. Under this system, the company has limits on the amount of carbon dioxide they can produce. If it exceeds this limit, it must participate in environmental projects to compensate for excessive pollution. However, this is not one of the effective instruments with the impression of deforestation, as corporations

gain more access to forests and have the opportunity to use it more for deforestation than for environmental projects.
Strong efforts have also been made to prevent deforestation at both local and national level. For example, students from the Federation of Secondary Schools, National Forest Institutes and other institutions met in 2010 to create a national reforestation plan to plant 1.5 million trees with secondary school students.
At the same time, the Forest Management Board has developed a wood certification system to help properly mark forest trees, thereby retaining greater control over non-compliance. However, the overall impact of this program was very low in developing countries. And that's because of high corruption. A law that has many so-called "gaps" allows large businesses to continue illegal exploitation.

Conclusion
Nicaragua is a country filled with biodiversity, and while I recognize that its tropical forests can make a significant contribution to the country's economy in the short term, it is important to remember the long-term development. The best way to ensure that the deforestation rate does not continue at such an extreme rate is greater support and enforceability by the state.

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Souhrn
Odlesňování a fragmentace lesních porostů patří mezi hlavní složky globálních změn a obě přispívají k rychlému úbytku území tropického lesa s významnými důsledky pro fungování ekosystémů a ochranu biodiverzity. Odlesňování je přímo spojeno se zánikem druhů, ztrátou ekosystémových funkci, zvýšenými emisemi CO2 a dalších skleníkových plynů a změnami struktury a kvality biotopů vodních ekosystémů. Odlesňování nejen redukuje plochu lesa, ale také mění konfiguraci krajiny. Fragmentace zvyšuje izolaci biotopů a zvyšuje aspekt okrajového efektu (edge effect).
Jedním z hlavních environmentálních problémů Nikaraguy v tomto okamžiku je právě odlesňování a fragmentace lesních porostů. Tento problém je způsoben nekontrolovatelným rozrůstáním se extenzivního chovu dobytka, neudržitelným zemědělstvím a růstem populace. Důvodem je, že nikaragujská ekonomika je přímo závislá na zemědělství a chovu dobytka. Dalším důvodem je dopad klimatické

změny, kdy celý středoamerický region je postižen 3letým obdobím extrémního sucha způsobeného klimatickým fenoménem El Niño. V neposlední řade, k deforestaci přispívá i podíl nelegální těžby.
Mezi lety 1990 a 2000 Nicaragua ztratila v průměru 99 900 hektarů lesa ročně, což činí ztrátu 1,53 % ročně. Celkově mezi lety 1990 a 2005 ztratila Nicaragua 20,6 % lesního porostu nebo kolem 1 349 000 hektarů.

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NOISE INTENSITY IN THE AREAS OF TOURISM AND RECREATION — EXAMPLE BASED ANALYSIS

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Abstract

Noise is one of environmental pollutants, it causes that the natural environment loses its essential value, which is silence, also reduces the value of recreational and therapeutic areas, changes the behavior of birds and other animals. This factor also has an adverse effect on the people: it accelerates and deepens fatigue, it decrease the visual acuity and the faculty of observation and it delays defense reactions. Under the influence of noise, nervous tension increases (stress). Acknowledge at close relationship between noise and the occurrence of mental disorders.

The noise level in recreational and recreational areas should not be higher than 65 dB during the day. At the same time, the tests of the National Institute of Hygiene show that a person feels acoustic comfort if Leq D (equivalent level of sound A) is not higher than 50 dB. Many recreational and tourist forest management facilities are exposed to the direct impact of traffic noise, although from these places are expected peace and quiet, which are conducive to the regeneration of mental and physical strength.

This work aims to assess the degree of noise pollution in selected places of recreational forest management in the Marcule Forest District. For the measurements, three recreational development points were chosen located close to national roads, which is a popular resting place, for comparison, a recreation point located 5 km from noise sources (roads) was also selected. A significant difference in sound intensity between the reference surface and the relevant measuring points was observed. Obtained sound intensity results do not exceed acceptable standards, but indicate that in a significant way noise can affect the discomfort of rest.

Key words: communication noise, environmental pollution, Marcule Forestry District

Introduction

In recent decades, environmental protection has become necessary due to a huge development of technology and industry which took place in the previous century and still continues. The Industrial Revolution, which resulted among other things in the introduction of steam machines to the factories or railway industry, has led also to many unintended effects, such as environmental pollution. Apart from such common types of pollution as water or soil pollution, noise pollution should be also distinguished. Noise and vibration deteriorate the quality of the natural environment through the loss of silence being the substantial value of this environment, as well as through the reduction in the value of recreational areas and the change in the

behavior of birds and other animals (Leśniak-Matusiak, Wnuk 2014). Noise also has adverse effect on human health and welfare.
Noise is defined as unwanted, unpleasant, annoying and harmful acoustic vibrations of compressible media, which affect humans through air, and in particular their organ of hearing. The issue of noise is known globally. The European Environment Agency published in 2016 a report of noise pollution which shows that environmental noise in metropolitan areas and from the largest European roads affects more than 100 million people and causes 16 600 cases of death each year (www.eea.europa.eu/pl/themes/noise/about-noise). A large share of noise emitted into the environment holds road traffic noise which accounts for 29% of noise from other sources (Engel et al. 2010). Road traffic noise exceeding 60 dB is present on all national and express roads. Due to the fact that the number of vehicles on these roads increases, the area polluted by such noise also enlarges thus raising the number of people affected by it.
Different types of pollution in a place of residence and work of many people, in particular those living in cities, cause that they are willing to spend their leisure time (holidays, weekends) close to nature: by the sea, by the lakeside, in the mountains or forests (Krzymowska–Kostrowicka 1997). They expect that these places should be free from motor vehicle exhausts and noise. The aim of the study is the analysis of the level of noise in selected points of the management of forests for tourism and recreation in Marcule Forest District, and the assessment of the potential influence of the noise on the forest users.

The influence of noise on human organism
The nuisance of noise results from the fact that it distorts verbal communication, and also disturbs relaxation and concentration. The sound in general is perceived as noise differently by each individual. This largely depends on personal characteristics such as age, health condition, or mental resilience. Noise affects human mental well-being and nervous system, and consequently has a negative impact on human physical health (Żukowski 1996).
Due to its harmful effect, three main areas of the impact of noise on humans can be distinguished:
a. direct impact: hearing,
b. indirect impact: the nervous system and mind
c. an effect on other organs.
Due to the different impact of noise on human body, and thus different harmful effects on health, noise levels can be as follows:
• below 35 dB(A) — not harmful to health, can be annoying or interfere with work requiring concentration,
• 35 ÷ 70 dB(A) – affects human nervous system causing its fatigue, severely impedes speech intelligibility, disturbs sleep and relaxation,
• 70 ÷ 85 dB(A) – significantly affects work productivity, may be harmful to health and cause hearing damage,
• 85 ÷ 130 dB(A) – causes numerous negative health outcomes, makes speech unintelligible even from a distance of 0.5 m,
• above 130 dB(A) – causes permanent hearing damage, makes internal organs vibrate thus leading to their disorders
(https://www.senat.gov.pl/gfx/senat/pl/senatopracowania/30/plik/ot-612_inter.pdf).
The main purpose set out in Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 is to define common measures and actions aimed at

reducing and preventing harmful effects of noise. The following actions should progressively be implemented:

a) noise mapping in order to determine the degree of exposure to noise;

b) ensuring public access to all the information relating to environmental noise and its effects

c) based on the data obtained from noise mapping, the Member States should adopt action plans aimed at preventing environmental noise and noise reduction, particularly in areas where it adversely impacts human health.

The Regulation of the Minister of the Environment of 14 June 2007 specifies permissible levels of sound A (LAeq) for instance for recreational areas; for noise from roads and railways the levels are 65 dB during the average day period and 56 dB for the average night period. For other objects and activities being the source of noise the permissible levels are 55 dB during the day and 45 dB during the nighttime.

Materials and Methods

The research concerning the level of noise has been carried out within the premises of Marcule Forest District about 40 km away from Radom. The national road 9 leading from Radom to Rzeszów runs through the forest district.

The forest district itself is a very important area for recreation and education for the residents of surrounding villages. In 2006, at the headquarters of the forest district the Nature and Forestry Education Center was founded along with the Arboretum which holds the collection of approximately 600 species and varieties of trees and shrubs of the entire temperate zone. In addition, there is also a place for bonfires and a parking area. Unfortunately, the objects are located by the aforementioned national road.

The places for conducting the research on noise intensity were chosen based on observations made, and also on the interviews with the forest district workers concerning the spots of tourist and recreational development most frequently chosen by visitors either for a short break or to see a tourist attraction. On that ground five measurement points were selected with the highest intensity of use. All the points are situated in the vicinity of the forest district office and these are as follows:

1. a parking lot with a place to rest
2. a shelter with a fire pit
3. an education point "Papal Oak"
4. "Oak Marcel" monument of nature
5. an animal park

In addition, for the sake of comparison, the noise intensity level was also measured in three spots of an education point at the nature reserve "Piotrowe Pole" located at a distance of 5 kilometers as the crow flies from the national road 9.

A schedule of measuring was established based on observations of the volume of traffic on the national road 9 and the number of people visiting selected recreational and educational facilities. Data were collected three times a week within the period of four weeks. For each of the five points 12 measurements were made, each lasted for 20 minutes. All the measurements were made in the A-weighted system, within a measuring range of 35-95 dB with the use of the sound level meter SON-50. The data recorded afterwards were as follows:

- L_{Aeq} (the equivalent sound level), in dB – an average A-weighted sound level variable in time, at which the response of the organ of hearing is the same as the response to the noise of a constant level in an equivalent period of time.
- L_{ASmx} (the maximum effective from the beginning of the measurement). This value is used to evaluate short duration noise and impulsive noise of high intensity.

Results

The averaged results from all the measurements carried out in the selected points show that the equivalent sound level L_{Aeq} was 56.3 dB, whereas the value L_{ASmx} was 62.8 dB. The admissible noise level for recreational areas, according to the Regulation of the Minister of the Environment of 1st October 2012, is 65 dB. The result obtained indicates that in this case the permissible levels of sound were not exceeded. However, the result reveals that recreation in these locations may be disturbed because the noise exceeding 35 dB causes the fatigue of the nervous system, seriously impedes speech intelligibility, and disturbs sleep and relaxation.

The averaged results obtained from the comparative area illustrate the great impact of the national road 9 on the acoustic conditions. The equivalent sound level value L_{aeq} on the comparative object is lower by 14.57 dB and equals 41.7 dB, while the value L_{ASmx} is 50.22 dB.

Average results obtained from individual days of the week were not subject to significant fluctuations. The highest L_{aeq} value was registered on Sunday (56.8 dB), when the number of visitors was the largest. Not much lower value was noted on Thursday (56.3 dB), while the lowest was recorded on Friday(55.64). The average L_{ASmx} was similar for all days and fluctuated between 67-68 dB.

While analyzing the noise on each of the main test points it should be noted that the highest L_{aeq} value was registered in point 1 (parking lot) and it was 58.18 dB. The result obtained was influenced by the cars moving around the parking lot, as well as coaches and cars using the road to the forest district office. On the other hand, the lowest equivalent sound level value was recorded in point 5 (54.92 dB). This was influenced by the distance of 90 meters from the national road. While comparing points 2 and 3, which are situated within the distance of 20 meters from the national road, it was noted that the result recorded in point 2 was lower by 1.96 dB (the volume increase by approximately 3 dB means a twofold increase in noise intensity). Such result discrepancies may stem from the fact that vegetation can be found between point 2 and the road, whereas between point 3 and the road there is only a wooden fence. The results obtained from point 4 were as follows: L_{Aeq} – 55.21 dB and L_{Amx} – 66.9 dB

Conclusion

1. Pursuant to the Regulation of the Minister of the Environment of 14 June 2007 which specifies permissible levels of environmental noise, the facilities in the vicinity of the national road 9 are not polluted with traffic noise.
2. The close proximity of the national road 9 greatly affects acoustic properties prevailing at the site of the research. The equivalent sound level on the comparative surface was 41.73 dB, which makes a difference of as many as 14.57 dB when compared to the facility located in the vicinity of the road.
3. Barriers such as vegetation or fencing situated between the measuring point and the road also influence the noise level.

4. The level of noise at the measurement points enables normal voice communication, in some cases there is a need to communicate with raised voice.
5. The average sound level exceeding 50 dB present at the tested locations does not cause irreversible changes in the human body, but it can cause headaches, fatigue, and nervousness. This does not promote the regeneration of vital forces of persons spending their leisure time in these areas and may hinder the work of a forest education teacher.

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Souhrn

Hluk je jednou z environmentálních znečišťujících látek, způsobuje, že přirozené prostředí ztrácí svou základní hodnotu, což je ticho, také snižuje hodnotu rekreačních a terapeutických oblastí, mění chování ptáků a jiných zvířat. Tento faktor má také nepříznivý účinek na lidi: urychluje a prohlubuje únavu, snižuje vizuální ostrost a schopnost pozorování a zpomaluje obranné reakce. Pod vlivem hluku zvyšuje nervové napětí (stres). Uvědomte si blízký vztah mezi hlukem a výskytem duševních poruch. Hladina hluku v rekreačních a rekreačních oblastech by během dne neměla být vyšší než 65 dB. Současně testy Národního hygienického ústavu ukazují, že osoba cítí akustický komfort, jestliže Leq D (ekvivalentní hladina zvuku A) není vyšší než 50 dB. Mnoho rekreačních a turistických lesních zařízení je vystaveno přímému dopadu hluku z provozu, ačkoli z těchto míst se očekává klid, což přispívá k regeneraci duševní a fyzické síly. Cílem této práce je posoudit stupeň hluku ve vybraných místech rekreačního lesního hospodářství v oblasti Marcule. Pro měření byly vybrány tři rekreační oblasti, které se nacházejí v blízkosti národních silnic, což je oblíbené místo odpočinku, pro srovnání byl vybrán rekreační bod umístěný 5 km od zdrojů hluku (silnice). Zaznamenal se významný rozdíl v intenzitě zvuku mezi referenčním povrchem a příslušnými měřícími body. Dosažené výsledky intenzity zvuku nepřekračují přijatelné standardy, ale naznačují, že hluk může významně ovlivnit odpočinek.

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OCCURRENCE OF THERMAL INVERSIONS IN VEĽKÁ FATRA NATIONAL PARK PRESENTED AT VERTICAL TRANSECT RUŽOMBEROK – VLKOLÍNEC LOCALITY

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Abstract
In the presented paper we observed the thermal inversions in the period from December 2012 to February 2014 in Liptov basin at Ružomberok and Vlkolínec locality. Ružomberok (494m altitude) is a town in the north of Slovakia and the industrial center of Lower Liptov. Vlkolínec is a monument reserve of folk architecture with an altitude of 718 m. Since 1993, it has been included in the UNESCO World Heritage List. Research areas are part of the Veľká Fatra National Park. The inversion represents a meteorological effect when the temperature of the air does not decrease but increase with the altitude. The ecological effect of inversions is based on the creation of the environmental conditions. The inversions contribute to the worse quality of the atmosphere because of the toxic substances held at the surface atmosphere layer.
We were investigating the presence of the inversions by comparing the temperature at both areas. We evaluated information considering the month, the year 2013 and the season. In the year 2013 we noticed 232 days with the inversion. During inversions we also observed the creation of the fog. The presence of the fog was represented by the 98% air moisture or more at the lower altitude.

Key words: temperature, fog, the Liptovská kotlina basin, ecological and environmental significance

Introduction

Thermal inversion is a specific meteorological phenomenon representing deviation from the normal temperature-associated ordering of particular atmospheric layers. The town of Ružomberok is situated in a basin surrounded with broken- topography-terrain which provide favourable conditions for inversions origin and persistent occurrence.
Our research aim was to record the inversions occurrence in individual year season and to assess their possible ecological and environmental impacts for across the study area. Inversion episodes can persevere from several ten minutes to several days (Krečmer , 1980). Temperature inversions are most frequent during autumn and winter (Schuster et al., 2013). In summer, due to prevailing insolation, the inversions are rarer, limited primarily to night. The inversion days' number is depending on weather circumstances (Petrovič, 1967), but the temperature and properties of the individual types vary with the year season (Chromov, 1968). The most common cause for inversion is radiation-related ground cooling during night, with cloudless weather in higher situated zones (Seifert,1993). During clear weather, inversions can last over the whole day, reaching altitudes of several hundred meters as far as the there is more radiation than insolation (Chromov, 1968).

Air pollution during inversions

The occurrence of inversions in basins, associated to low-speed winds and local meteorological conditions, is conclusive for the local emission load. Inversions represent favourable conditions for higher atmospheric pollutants concentrations in atmosphere, principally in winter (Minďáš, Škvarenina 1994). In urban areas, there is also noticeable transport of PM10 particles from motorways, contributing significantly to the town climate constitution (Středová et al. 2015; Škvareninová et al. 2017). For the pollution impact assessment, the length and frequency of inversions are also determinant (Piringer et Kukkonen, 2001; Fazekašová et al. 2016). Inversion impedes the polluted air to rise and spread, which forces the smog to concentrate under the inversion layer and initiate local flows of pollutants, acid precipitation and heavy metals into the mountain areas (Plieštiková et Škvarenina 2009).

Materials and methods

We observed the occurrence of inversions in the territory of Ruzomberok. The main studied locations were stations - Ružomberok (RD) and Vlkolínec (RH). The height difference between the stations is 222 m. The position and altitude are shown in Tab. 1. The incidence of inversions was observed from December 2012 to February 2014.

Tab. 1: Monitoring stations

Station	Symbol	Latitude	Longitude	Altitude
Ružomberok town	RD	49° 4' 52,54ŧ	19° 17' 52,34ŧ	496m asl
Vlkolínec settlement	RH	49° 2' 19,38ŧ	19° 16' 37,96ŧ	718m asl

The station RD is situated in a garden in a built-up area.. The station RH is situated outside the built-up areas of the Vlkolínec settlement, on a moderate, SW-facing slope. The data from these two localities were collected with the aid of a measuring equipment Minikin RTHi situated at 2 m above the ground. There were recorded temperature and humidity values at 10-min intervals. The inversion occurrence between the two stations was identified base on the definition stated by Petrovič (1953). At inversion occurrence, there was surveyed the momentary temperature difference between the stations. Consequently, there was evaluated the maximum temperature leap for the relevant month according to Chromov (1968). The difference size was the base for classifying the inversions into categories (Table 2) according to Petrovič (1953)

Tab. 2: Inversion classified according to the momentary temperature difference

Inversion	**Momentary temperature difference**
weak	0,1–3 °C
moderate	3,1–6 °C
strong	6,1–9 °C
massive	9,1–12 °C
extremely massive	12,1 °C and more

The inversion occurrence according to the episode length and temperature leap was evaluated in relation to the climatic seasons: winter 2012/13 (December 2012–February 2013), spring (March -- May 2013), summer (June–August 2013), autumn (September–November 2013), winter 2013/14 (December 2013–February 2014).

Studied area characteristics

The Liptovská kotlina basin belongs to the biggest basins in the Tatra region. Tha basin is enclosed by the mountain ranges the Chočské vrchy Mts., Tatra Mts., Kozie chrbty Mts. and Veľká Fatra Mts. The climate is typically continental, showing distinct differences around-the -year. The territory of Ružomberok encompasses from the moderately warm to the cold mountain climate (Vlkolínec). The mean monthly temperature in January is ≤ - 3 °C, in July ≥ 16 °C. The mean annual temperature is ≥ 6 °C. The number of inversion days is > 148. The growing season, with a temperature of > 10 °C represents 138–152 days. The average number with fog occurring on slopes within submountain and mountain positions is 20 – 50, in the basin 40 – 50 , in mountain river and stream valleys 50 – 60 and in the territory of mountain advection fogs 70 – 300 (Mindáš et Škvarenina, 2002). The precipitaton amount rises with altitude, with a rate of 60 – 80 mm per 100 m (Zeleňáková et al. 2017). The studied territory is a part of the National Park Veľká Fatra (Čech et al., 2000).

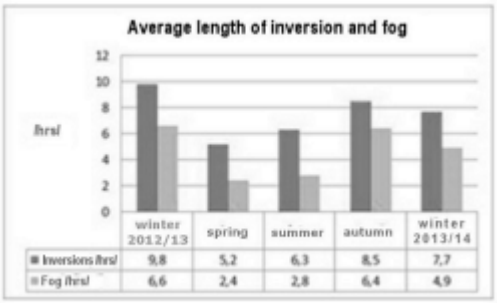
Results

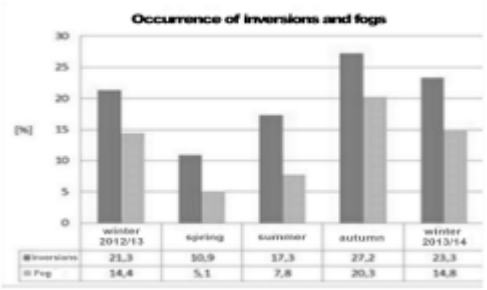
Over the entire study period, the temperature differences between the two stations indicated that inversions were present in each month of the period. Altogether, there were recorded 297 inversions representing 2244 hours (93.5 days). The most frequent inversion occurrence was in autumn (27.2%) and in winter (23.3%). The lowest one was observed in spring (10.9%), followed by a continual increase to autumn (27.2%, Fig. 1). Fog accompanied mostly autumnal inversions (20.3%), the rarest fog occurrence at inversions was observed in spring (5.1%, Fig. 2). The maximum fog presence associated with inversions (87.1%) was recorded in November 2013.

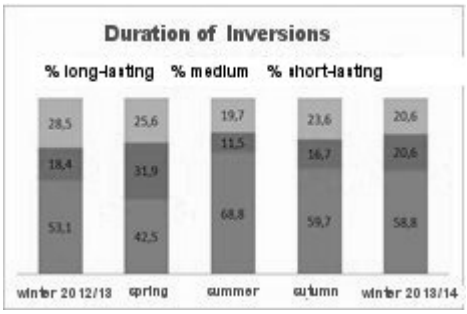
Long-lasting inversions (> 4 hours) were dominant in all the seasons studied. With exception of spring, prolonged inversions represented more than one half of all inversion events (Fig. 3). The detected temperature leaps detected inversion intensity from weak to extremely strong (Fig.4). In all the monitored seasons, the major proportion was of weak inversions. In spring and in winter 2013/14, there were recorded by one extremely strong inversions.

Discussion

Our research aim was to investigate theoretically the generation of inversions and their accompanying phenomena along the vertical transect Ružomberok – Vlkolínec. The over-annual presence of inversions allow us to confirm the essential role of the Ružomberok area land morphology for developing inversions. Consequently, there can also be supposed occurring the phenomena reported by Soták (2000) and Prošek et Rein (1982). According to the Regulation 112/ 1993 of the ME SR, the town of Ružomberok has been classified as a territory loaded with airborne pollutants (www.enviroportal.sk, 2014), which means that the inversion occurrence at this locality must be declared as an adverse phenomenon. In connection, with impacts from industry, transport and other stationary sources, there are frequent smog episodes, especially in autumn and in winter.







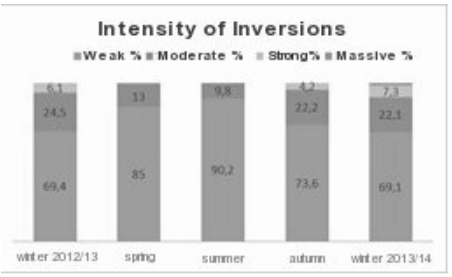


Fig. 1: Average length of inversion [hours] and fog episodes [hours] in the studied climatological seasons
Fig. 2: Inversion occurrence [%] and fog occurrence [% from inversions] during the studied climatological year seasons
Fig. 3: Inversions occurrence and length [%] in the particular climatological year seasons
Fig. 4: Inversion intensity in the studied climatological year seasons

Over the year 2013, there were recorded 232 inversion days (representing 63.6% from 365), which is on average by 25 % more than the average value for the Liptovská kotlina basin (www.ruzomberok.sk, 2014). Similar inversion days numbers were observed in autumn (65), in winter 2013/14 (62) and in summer 2013 (62).
Inversion occurrence in cold autumnal season is accompanied with extensive concentrations of atmospherically pollution originated especially from heating. We may suggest that the major environmental impact in this season is due to the inversions associated with fog during rush hours in morning and in afternoon, as the town is an important transport crossing of motorways of international importance. The severity of this territory pollution during inversions is a cardinal problem aggravated by the industrial character of the land.

Conclusion
The monitoring of inversion episodes has confirmed their year-round occurrence for the town of Ružomberok. In 2013, we recorded 232 inversion days. Our data have also confirmed the inversion occurrence and duration peaks for autumn and winter. On the other hand, the summer inversions occurred more frequently and lasted longer than we supposed. The most frequent inversions were observed during anticyclones, which is in accord with findings obtained by other authors. As for their frequency, inversions are to be considered as a key climatological circumstance sharing the deterioration of air quality in the town of Ružomberok.

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Souhrn
Předložený článek se zabývá monitoringem výskytu teplotních inverzí v období prosinec 2012 - únor 2014 v Liptovské kotlině na výškovém tranzekte Ružomberok - Vlkolínec. Výzkumné lokality jsou součástí Národního parku Velká Fatra. V příspěvku definujeme pojem teplotní inverze, její vznik, typizaci, trvání, vliv klimatických podmínek pro její vznik jakož i doprovodná meteorologické jevy. Přítomnost inverzí byla stanovována porovnáním teploty na výše a níže položené stanici v uvedených lokalitách. Získané údaje byly vyhodnoceny vzhledem na měsíc, roky 2012-2014 a klimatologické roční období.

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OTHER TYPES OF RECLAMATION AS A PART OF TOURISM DEVELOPMENT IN AN ANTHROPOGENICALLY AFFECTED LANDSCAPE

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Abstract
Surface mining of brown coal has been affecting the environment of the north-western part of the Czech Republic (the Most basin) for nearly 200 years. Regions affected the most are Chomutov, Most, Teplice and Ústí nad Labem. The consequences of coal mining are mitigated by reclamation and restoration processes. Besides forest, agricultural and hydrological reclamation, there is a relatively high share (18.3%) of so-called other reclamations that serve mainly as recreational areas. The end of the mining will cause increase of these types of reclamation, because the newly created recreational centres will be attractive for tourists. These new areas will also improve social and economic situation and thus ensure sustainable development of the whole region. The contribution is focused on examples of other reclamations in the anthropogenically affected region that were successfully integrated into the landscape and that are recreationally used. The next part is concentrated on the overall status of tourism in the region and how the other types of reclamation could affect it in the future.

Key words: sustainable development, coal mining, recreation, North Bohemia

Introduction

In 2016, mining in the North Bohemian Brown Coal District reached 31.07 million tons, and production on this territory under the Ore Mountains is carried out by Czechoslovak Army, Vršany, Libouš, and Bílina Quarries. According to current plans, given a similar annual mining volume and in compliance with the existing limits in the Czechoslovak Army Quarry, mining in the North Bohemian Brown Coal District should end between 2050 and 2055. This will be done by mining the last of the coal supplies in the Vršany Quarry in the Slatinice extraction area and the Bílina Quarry, whose continuation beyond the originally stipulated limits was decided on by the government in October 2015 by Government resolution No. 827. The consequences of coal mining are mitigated by reclamation and restoration processes. The greatest future potential have so-called other reclamations which include public green spaces, roads, recreational and resident areas, cultural and educational areas and areas for business activities. This type of reclamation is gaining popularity because it can react on current demand for recreation and its possible commercial use can help to improve economic development of the area.

Materials and methods

Methods of research consisted firstly in studying available materials that are connected with landscape recovery in the model area. The main documents were Mining Yearbooks Individual companies participating in the restoration of the landscape after mining in the Most Basin describe here the amount of completed reclamations. Professional experience and results of several researches done by Faculty of Environment of the J. E. Purkyně University provided necessary information to analyze acreage of completed and planned reclamations in the model area.

Forest reclamations represent now the highest share (47 %) within the reclamations finished in 2016 in the monitored area. Next in line are agriculture reclamations (30 %), and then there are other (16 %) and hydrological reclamations (7 %). The share of forest and agriculture reclamations will decrease in the future for the benefit of hydrological and other reclamations. The share of hydrological reclamations will increase by almost 10 % thanks to the possibilities of utilising residual quarries after the end of coal mining by flooding them. The largest artificial lake made is Lake Most, with 316 hectares. There will be more of them in the future, because still active quarries (ČSA, Bílina, Vršany-Ŝverma, Tušimice) are planned to be flooded to. The largest one will be created by flooding the ČSA quarry with 1259 hectares. Those lakes will be also used recreationally. Other reclamations will increase too, by 8 %, but it is necessary to say that in this case the share of planned other reclamations can change in the future as the demand for recreational areas will be higher (Fig. 1).

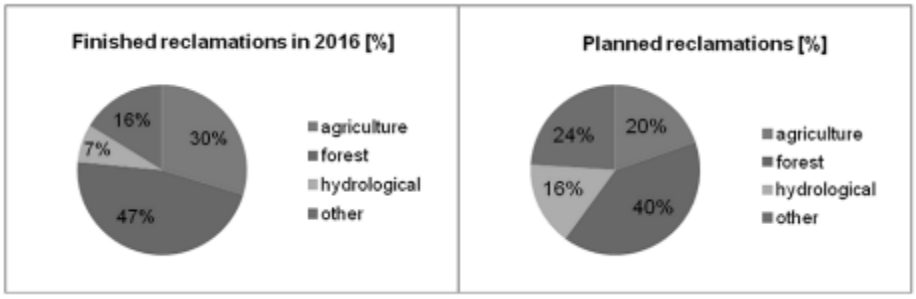

Fig. 1: Finished and planned reclamations in the monitored area [%]. (Mining Yearbooks 2005 – 2016)

From 2005 to 2009 the acreage of other reclamations was increasing rapidly (1478,61 – 2193,3 ha). Then there was a period of slower positive development up to 2206,6 ha. In 2013 there was monitored a reduction of other reclamations by 49 hectares. We believe that this decrease was caused either by converting certain part of reclaimed land into another type of reclamation or by extension of mining. Since 2014 there has been observed an increase up to the last known acreage of 2230,3 hectares (Fig. 2).

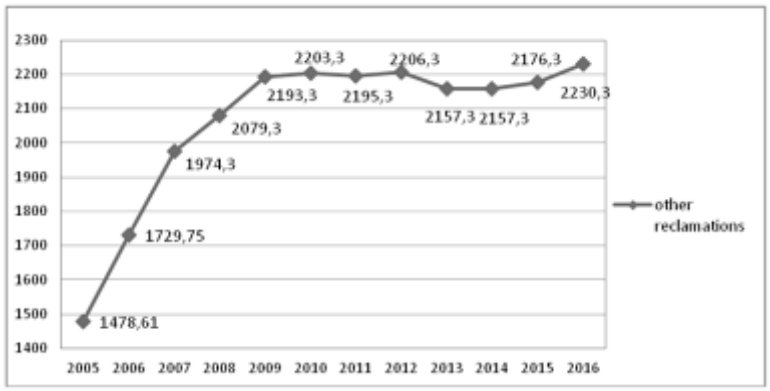

Fig. 2: Development of other reclamations (2005 – 2016) in the monitored area in hectares (Mining Yearbooks 2005 – 2016).

Results

Following examples represent successful reclamations around the city Most that are concentrated on tourism. Although hydrological reclamations are also used recreationally, they are not included in this list as they were described in another contribution Vráblíková et al, 2017. The summary of recreationally used areas made by other reclamations is necessary for evaluation of tourism potential of this athropogenically affected area.

Autodrome

The Most Autodrome is a car racetrack that was established in 1983 on a external spoil tip of Vrbenský quarry. The reason for building the racetrack was a long term tradition of car racing in the city since 1945. The Autodrome was reconstructed in 1995 and the tribunes can hold up to 200 000 viewers (Valášek, 2009). It is used not only for races but also for test drives. The most popular event is annual truck race that usually takes place in September. The event attracts more than 50 000 spectators. In 2005 the racetrack opened a Polygon which serves as training grounds for driving safety courses, school of drifting and courses to obtain racing license. (www.autodrom-most.cz).

Hipodrome

This horse racetrack and sports grounds was cerated within reclamation of Velebudice spoil which is the largest in the Most region. The purpose was to create a new public green space where the horse ranec track would be the dominant element. Construction works started in the 80s and the first race took place in 1997. Now there is a rating oval, parkour racetrack and great facilities for competitors and the viewers. The races are held from April to October. Since July 2008, there has been a 3,370-meter-long track for inline skating here, which was built along the perimeter of the horse racing track (www.mesto-most.cz, 2018).

Aerodrome

The aerodrome is a domestic airport that was built 3,5 km from the city Most on an external spoil tip Střimice. The airport was opened in 1996 and serves to host major national and international aviation events, for example championship in parachuting or in aeronautical acrobatics. The aero club offers sightseeing flights, tandem jumps or skydiving school. (www.letistemost.cz).

Golf course

The golf course was cerated in 1993 as a part of reclamation of Velebudice spoil tip. The First Golf Club Most is playinng on a nine-hole course, but there is a plan to extend it into eighteen-hole course in the future. The golf course is open from April till October (www.golfmost.cz, 2018).

The Benedikt grounds

The Benedikt grounds is the most visited recreational complex in the Most region. Its location is convenient because it is in the immediate vicinity of a densely populated neighbourhood. In a period 2000 – 2004 the complex was rebuilt and restored. The water tank was divided into two smaller tanks. The digger one now serves as a natural aqua park and the smaller on for fishing. Because of the popularity, there were built beaches, playgrounds (beach volleyball, basketball, field hockey, mini-golf), facilities for the visitors, fencing of the whole area and an administrator was employed (Valášek, 2009).

Other forms of tourism connected with reclamations
Examples below describe other forms of tourism that are closely related to reclamation or to the coal mining industry. These activities help bring reclamation and mining processes closer to visitors.

Coal safari
The term Coal safari refers to excursions into the Most coal basin by mining companies Vršanská uhelná and Severní energetická. This allows the public to learn about the technology of brown coal mining, as well as the regeneration of the landscape after mining (www.uhelnesafari.cz).

Off-road safari
This guide offers thematic tours by off-road vehicles through the industrial landscape of the Most region. The tours can be focused on coal mining, palaeontology, 2nd Word war or on nature of the Ore mountains (www.imostecko.cz, 2018).

Podkrušnohoří technical museum
In 2003, the Podkrušnohoří Technical Museum was established on top of the former Julius III underground mine in Most-Kopisty, whose main aim is to show the public the history of coal mining and processing in the central part of the North Bohemian brown coal basin (www.ptm.cz, 2018).

The Mining Heritage of the Ore Mountains
In its industrial form, mining is still part of life in the foothills of the Ore Mts. You can visit two mining monuments (stoles) in the Ore Mountains near Most – Lehnschafter in Mikulov and Old Martin in Krupka (www.imostecko.cz, 2018).

Discussion
The Ústí region in comparison with the Czech Republic is not a very popular destination for tourists. Only 2,9 percent of all guests in accommodation facilities in CR were registered in Ústí region in 2016. But overall development of guests visiting Ústí region can be defined as positive (Fig. 3). Decreasing number of guests from 2007 to 2010 was followed by continual increase up to 527,5 thousand guests in 2016. Also the acreage of other reclamations in the monitored area was the highest in 2016 (Fig. 2).

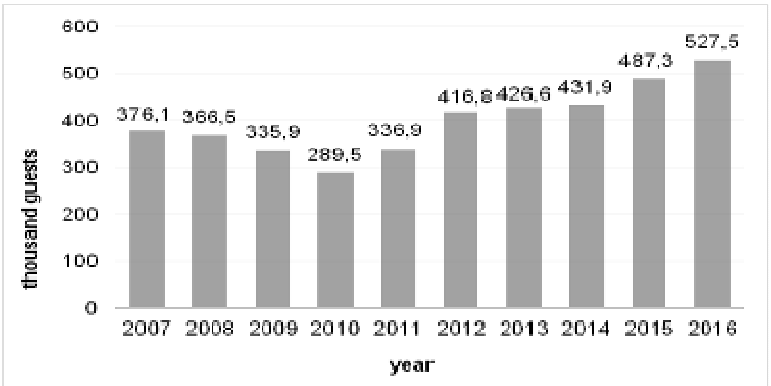

Fig. 3: Number of guests in accommodation facilities in the Ústí region 2007 – 2016 (Statistical Yearbook of the Ústecký region, 2017)

Positive development can be observed in the model area. The number of guests in accommodation facilities was in 2016 higher than in 2010. Substantial increase was monitored in the Chomutov and Ústí nad Labem districts. We believe that the increase in Chomutov and Most regions is connected with continual increase of finished reclamations (Fig. 4).

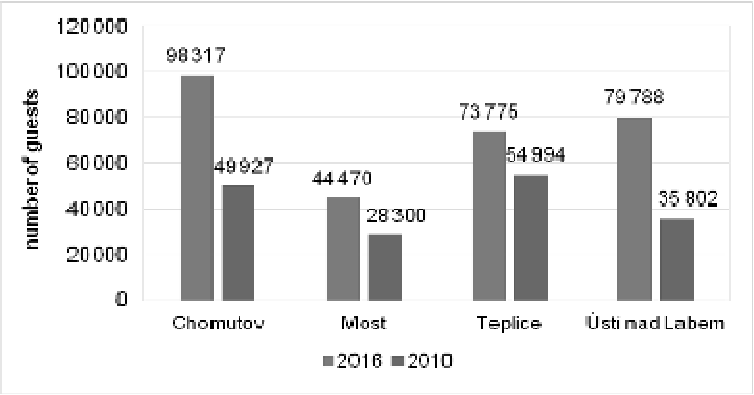

Fig. 4: Number of guest in accommodation facilities in the monitored area in 2016 and 2010 (Statistical Yearbook of the Ústecký region, 2017)

Conlusion

Reclamation processes are a main part of restoration of the monitored area (Chomutov, Most, Teplice and Ústí nad Labem districts) that is affected by superficial brown coal mining. The so called other reclamations are one way of anthropogenic landscape integration back to the environment. Main purpose of the newly created areas is recreation. That is why this type of reclamation is well accepted by the community. Individual examples of other reclamations (Autodrome, Hipodrome, Golf sourse, Benedikt grounds etc.) prove that this is the way of positive environmental, economic and social development of one of the most anthropogenically affected areas in the Czech Republic.

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Shrnutí
Povrchová těžba uhlí ovlivňuje životní prostředí severních Čech, resp. Mostecké pánve, již skoro 200 let. Nejvíce poškozené části jsou regiony Chomutov, Most, Teplice a Ústí nad Labem. Následky těžby hnědého uhlí jsou zahlazovány revitalizačními a rekultivačními procesy. Kromě lesnických, zemědělských a vodních rekultivací se na obnově krajiny po těžbě podílejí i takzvané ostatní rekultivace, které slouží převážně k rekreaci. S ukončením těžby dojde k navýšení tohoto podílu, jelikož nově vzniklé plochy jsou turisticky atraktivní. Tyto plochy zároveň zlepšují ekonomickou situaci regionu a tím přispívají k udržitelnému rozvoji. Ostatní rekultivace jsou velice dobře přijímány místními obyvateli i turisty. Jejich podíl dle dostupných údajů stoupá a jednotlivé příklady těchto rekultivací (Autodrom, Hipodrom, golfové hřiště, areál Benedikt atd.) dokazují, že je to cesta k pozitivnímu environmentálnímu, ekonomickému a sociálnímu vývoji jedné z nejvíce antropogenně zatížené oblasti České republiky.

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POPULARIZATION OF NATURAL AND HISTORICAL POTENTIAL OF THE SPECIAL NATURAL RESERVE OBEDSKA BARA (SERBIA) USING A FORM OF EDUCATIONAL TRAIL

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Abstract
Educational trails are a popular way of spending quality free time. They can make attractive locations accessible to the public while providing the opportunity for visitors to learn about, better understand and appreciate those unique sites. One of the interesting sites in Serbia without any educational trail to this day is the special nature reserve Obedska Bara. The area harbours extraordinary biodiversity - thanks to its natural values, Obedska Bara was declared both a Ramsar site and Special Protection Area. This paper focuses on the popularization of this special nature reserve through educational trail. After careful literature review, field research and photographic documentation, we have designed two educational trail circuits to highlight natural values of Obedska Bara. We also designed information boards including textual and visual information and route map. The construction of a new educational trail with information boards could besides presenting the significant natural values of the area also contribute to raising environmental awareness of the local population as well as that of wider public. This would also greatly contribute to the development of recreation and tourism as well as to the promotion of regional development in line with the principles of sustainable development.

Key words: special nature reserve Obedska bara, educational trail, information boards, tourism potential

Introduction

Educational trails provide quality leisure time for all visitors. Their potential lies in the diversity of the landscape and the enjoyment they can bring to visitors. Educational or themed trails can be defined as marked educational hiking trails running through the countryside along which there are marked both natural and cultural attractions and points of interest of the territory that are described in more detailed (Čeřovský et al., 1989; Bizubová et al., 2001). Nowadays, there are many educational paths in Slovakia and other countries in the world (Králiková et al, 2008). However, this is not the case for Serbia, which still does not have many educational trails. This situation is largely influenced by the political and economic instability in the country. The aim of this paper is to draw up a proposal for an educational nature trail in the Special Nature Reserve (SNR) Obedska Bara, which consists of a big and a small circuit. By creating a nature trail, we will try to popularize the site in Serbia and make it available to the wider public. The territory is located between 45º38'02" N and 44º46'05" N and between 19°47'16" E and 20°03'30" E (Puzović, 1995). The location of SNR Obedska Bara is a remnant of the meandering Sava River water channel and it represents a unique combination of standing water ecosystems, wetlands, wet meadows, peat bogs and forest ecosystems with a very rich biodiversity (Mišić, 1974; Stojanović, 2004). In SNR Obedska bara, three levels of

protection are declared, differentiated according to the possibilities of land use (Dunić et al., 1983). The area is characterized by extraordinary biodiversity and provides the right conditions for tourism development. Thanks to its unique natural features, this site was declared both Ramsar site and Special Protected Area Obedska Bara (Stajić, 1974; Amidžić et al., 2007). The territory has suitable conditions for the realization of an educational nature trail that would help to promote SNR Obedska Bara.

Materials and methods

As our goal was to design 2 paths of the educational nature trail, we have carried out a combined landscape ecology and sociological research in the area. Landscape ecology research was focused on a detailed analysis of the natural conditions of the area of interest. One of information sources for landscape ecology analysis was available academic literature and maps, complemented by results from our own field research and photographs. We conducted a sociological research by using a structured questionnaire. We approached 100 respondents who answered 11 closed questions focusing mainly on evaluation of their interest, or lack thereof, in constructing an educational nature trail in this area. To get cartographic information about the site, we used cadastral maps on a 1:10 000 scale. We created thematic maps based on a 1:25 000 scale base map that we obtained from the Geodetic and Cartographic Institute in Novi Sad. We have cooperated with experts from the Institute for Nature Conservation to identify the most suitable sites for placement of informative boards. The map outputs as well as the visual designs of the information boards were processed using the ArcViewv9.3. and QGis2.8.1-Wien programmes.

Results

We have designed an educational nature trail marked with informative boards in SNR Obedska Bara which is located in the south-eastern part of Sriem, between the municipalities of Kupinovo and Obrež. The informative boards contain textual and visual information, including a route map. The educational nature trail leads through the preserved natural ecosystems of SNR Obedska Bara. There are important plant and animal species such as water soldiers (*Stratiotes aloides*), European pond turtle (*Emys orbicularis*), Eurasian spoonbill (*Platalea leucorodia*), black stork (*Ciconia nigra*) or white-tailed eagle (*Haliaeetus albicilla*). The educational nature trail leads through the cadastral area of Pećinci and includes a small and large circuit. A small circuit is shorter and less demanding, suitable for families with children and school excursions. It is 7 km long and it has 8 stops. The big circuit is more demanding, with 12 stops and length of 15.5 km and it is suitable for more experienced visitors. Suggested circuits start at the parking lot in Kupinovo, near the Church of St. Luke, where the stop no. 1 and the first informative board is located. The first board contains basic information about the educational trail and map of suggested circuits. The big circuit is marked in blue and the smaller circuit in yellow. The stops are indicated on both routes by blue circles with number of the respective stop (figure 1). The circuits continue from the parking lot to the open-air museum "Etno dom" and to the Church of St. Luke in Kupinovo, where the stop no. 2 with second information board is located (Figure 2). Stop no. 3 offers the opportunity to see the remnants of the medieval fortress Kupinik and from there it continues to stop no. 4 – Matijevica Observation tower, located near the bird island (Fig. 3). Both circuits continue to stop no. 5 – “Economic forest” and from there to the last joint stop no. 6 “Crossroads”. At this point, the small circuit turns right to the east and it leads to the meadow and to the Church of Mother Angelina, while the long circuit goes northwest

to stop no. 7 – Great Rogozita Observation tower. From there, the path continues to stop no. 8, where the largest lake in the Oberska Bara named “Krstonošić" is located.

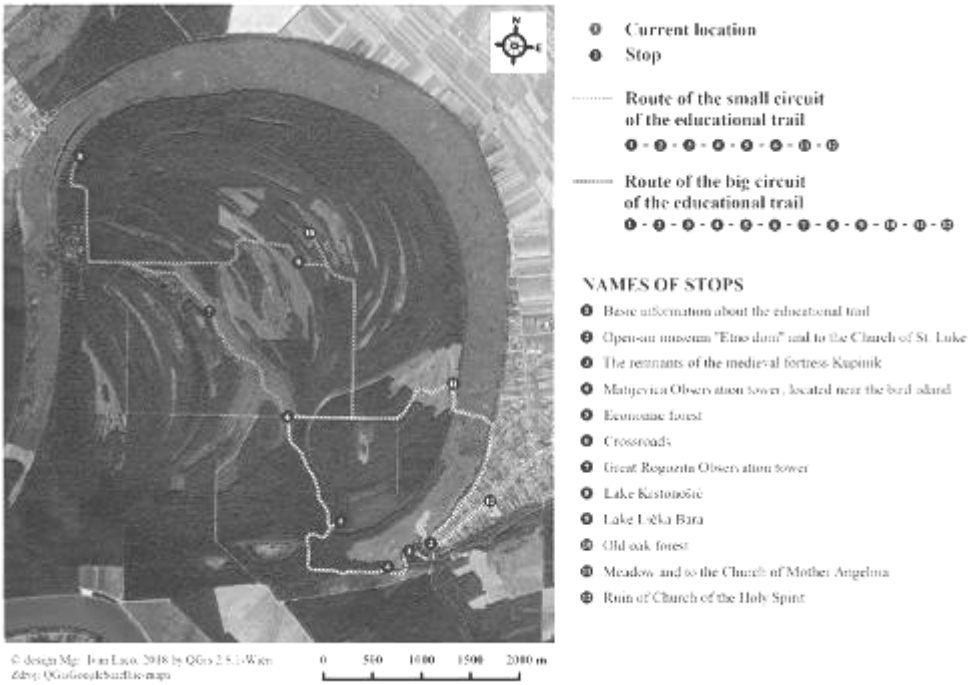

Fig. 1: Map of suggested educational trail in SNR Obedska bara

Fig. 2: Visualization of information board no. 2

Fig. 3: Visualization of information board no. 4.

The long circuit then continues to stop no. 9 to Lake Lička Bara. The stop no. 10 is another nature observation tower offering views to the old oak forest. The route then leads to the meadow and to the Church of Mother Angelina which is a stop no. 11. From the Church of Mother Angelina, both routes continue together to the last stop no. 12, to the ruin of Church of the Holy Spirit. Both circuits end at the parking lot. Before designing the educational trail, we were interested in whether the inhabitants of this area are actually in favour of constructing an educational trail. Therefore, we have prepared a questionnaire containing 11 questions. The questions concerned the educational trail and its construction in the area of interest. The survey results were as follows: of 100 respondents, 91 answered “yes” to the question: "I am interested in creating an educational trail and I would like to visit the site". Another important information that the questionnaire provided was that the surrounding schools were also interested in creating an educational trail. The educational trail was designed to promote one part of the SNR Obedska Bara that is located in Serbia. The proposed educational trail should contribute to the development of tourism and recreation as well as to the promotion of regional development in line with the principles of sustainable development.

Discussion

The role of educational nature trails is to attract people's interest in nature and environment. Their main objective is to explain and highlight the importance of ecosystems and natural resources in terms of biodiversity protection (Gebhard et al., 2006). Educational trails are part of an information system that includes historical paths, educational sites and nature museums (Rancsó, 2013). Most educational trails are located in large-scale protected areas where we can find various natural phenomena and particular natural features which are not suited for mass tourism. It is necessary to consider whether the increase in the number of visitors would not have negative impact on specific natural features and values of the site. It is inappropriate to design educational trails in places where natural conditions are particularly unique and the most vulnerable. According to Čeřovský et al., (1989) the trail should lead through the edge of the most interesting and precious natural sites. For this reason, we have designed a route that runs only at the edge of the most

valuable sites in the area (old oak forest, bird island) in order to avoid possible conflict of interests in the territory (Izakovičová, 1995). The Institute of Landscape Ecology of the Slovak Academy of Sciences also has experience with the design of an educational trail by participating in the international project CBC PHARE - SRT Joint Fund for Small Projects 2002/000 - 642.03-0013 "We learn from each other". The project led to the construction of the educational trail in the village Suchá nad Parnou (Cibira et al., 2005). According to Mariot (1983), localisation preconditions for tourism include natural preconditions and cultural-historical (man-made) preconditions and both of these precondition types are present in our interest area. Therefore, we believe that the construction of the educational trail could greatly contribute to the development of tourism and recreation in this territory.

Conclusion

We consider the construction of an educational trail in the interest area of SNR Obedska Bara as a potential opportunity to increase the interest of tourists in this attractive location, where the educational trail is still lacking. Creating an educational nature trail would significantly contribute to promotion of the site and thus increase the number of visitors in the area. Educational trails are very important because they educate visitors and encourage them to protect the environment and respect nature. We believe that in the future, we will be able to build this educational trail in cooperation with the municipal office of Pećinci, as it will contribute to the conservation of nature in SNR Obedska Bara, but also to education and awareness-raising of both local population and wider public.

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Souhrn
Článek se zabývá návrhem dvou okruhů navrhované naučné stezky v SNR Obedská Bara v Srbsku. Vidíme výstavbu naučné stezky jako příležitost k propagaci této oblasti v Srbsku. Navrhování vzdělávacích stezek vyžaduje odborné znalosti a zkušenosti. Harmonizace požadavků a vytvoření optimálního návrhu je náročná a měla by být individualizována pro každé konkrétní prostředí. Vytvořením vzdělávací přírodní stezky chceme přispět k ochraně přírody a rozvoje cestovního ruchu v této oblasti.

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POSSIBILITIES FOR AQUA PARKS USING IN TOURISM OF SLOVAKIA

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Abstract
Sector of tourism is one of the sectors with still receiving attention and place in national economy, but it is very sensible to any positive or negative changes at the market. Tourism is very often connected with relax, sports and recreation. Thermal sources of the country provide possibilities for such activities doing by the way of thermal and aqua park using. Slovakia is very rich on the thermal sources therefore the aim of the contribution is to search the present state of aqua parks using in territory of Slovakia, with consequent suggestion for new aqua park construction, which could strengthen economic growth in the region.

Key words: tourism, thermal park, aqua city, economic growth, Slovakia

Introduction

Sector of tourism is one of the sectors with still receiving attention and place in national economy. But it is not developed in all regions equally. Some regions are influenced by pleasant nature and high visitation. Other regions are less visited and people do not know about them. Tourism is also very sensible to any positive and negative changes of political, economic, social and environmental conditions. On the other hand tourism is most often connected with relax, sports, culture and nature. Individual type of tourism can have various forms, for example recreation tourism that has number of forms, as for example individual recreation, family recreation, etc. Recreation tourism presents not only passive, but also active relax in proper nature with goal to renew physical and mental strength. Staying in positive nature has influence to the organism and mental state of the people. The goal of health and medical tourism is not only for people with sicknesses, but also for relatively healthy people that want to be even healthier and by this way commercial element of tourism participants is increasing (spas, thermal aqua parks, etc.). One of the significant issues is their economy-ecology management in the frame of valid legislation and at the same time their effective use for healthy, recreational and regeneration purposes (You, et.al, 2017). In this area using of thermal water in aqua parks as tourism possibility could help to find new possibilities for the tourism improvement. Thermal water represents an important environmental and economic resource (Fabbri, et.al, 2017). Therefore aqua-park using must be considered according tourist destination attractiveness, when geographical and presentational approaches are oriented towards supply side. According Suhascaryo et.al (2017) thermal water has a potential which meets the standards as clean water and the heat capacity can be utilized to support as geological tourism. Sustainable utilization of thermal water and aqua parks has to be achieved through specific management policies, preserving their important environmental and socio-economic values (Axelsson, 2010). Yet few countries have systematically assessed their supply and linked it to the changes in motivation and behavior towards spas, health and wellness in their own population. (Joppe, 2010). In East Hungary the greatest extent of exploitation occurs in the area of Hajdúszoboszló and Debrecen, where thermal water is utilized mainly by baths (Buday, et.al, 2015). Borsukiewicz-Gozdur and

Zwarycz-Makles (2015) studied the geothermal well in order to supply heat to the newly built Aquapark Chochołowska Termy in Poland. Interesting research is also research Kapczyński and Szromek (2008), studying not only thermal water using in wellness area, but also life cycle of spas in case study of Poland. Clark-Kennedy and Kohen (2017) studied thermal water using in Australia in area of wellness, when suggested that while relaxation is currently the major driver of hot spring visitation, balneotherapy warrants consideration from health practitioners and insurers as a complementary therapy. In Serbia the research of thermal water using was made by Nakomcic-Smaragdakis et.al (2016) that concluded that balneology, spas, sports and tourism activities, as well as sanitary hot water supply and space heating are the most appropriate forms for direct use. Current situation and trends in geothermal water utilization in Croatia have been analyzed by Borović and Marković (2015) based on data gathering and observations with special attention devoted to their use for tourism purposes.
Especially Slovakia has rich nature, hidden under the earth, which means thermal springs and consequently various aqua parks operation and thermal spas. Pompurová (2011) examined subjective attractiveness of the Slovakia, found Slovakia tourist destination attractiveness in terms of subjectively evaluated offer is higher than its attractiveness in terms of subjectively evaluated demand. The biggest deficiency is the low availability of information about Slovakia as a tourist destination, which is crucial in visitors deciding where to travel and stay. Also Cuka and Rachwal (2013) made study, according which Slovakia aqua park tourism needs to improve marketing for target groups of domestic and foreign clients. It is important to plan sustainable utilization during each phase of geothermal site development cycle of aqua parks using (Borović and Marković, 2015).

Materials and methods

Research of present state of aqua parks using in Slovakia had been done by information, available on web sides. They had been compared with surrounding countries, such as Hungary, Czech Republic, Poland and Austria. During the evaluation we searched the quality of the web sides, what languages it uses, and what information can be obtained for the concrete localities. The part of the research was to find out visits in individual aqua parks or thermal parks in Slovakia by questionnaire. Questionnaire had been filled by 176 people, 92 women and 84 men, which present 52% women and 48% of men. As for the nationality, majority of respondents consisted from Slovakia – 153 respondents, presenting 87%, and 13% was from Ukraine, mainly 23 respondents. To evaluate aqua-park using required also knowing the age of the respondents. The most responds came from people from 46-60 year (102 people), the less group presented respondents between 36-45 years (9 people). From the view of employment, the biggest group presented 142 respondents and the less group presented two unemployed persons. Since tourism development is given by situation in individual regions, we requested also residence of respondents. Most responds came from Košice region and some respondents were from Ukraine. The object of searching was Slovakia, since the country is rather rich due to the geothermal sources, when yet 87% of geothermal water is using for recreation. Aqua parks in Slovakia increased in last years due to the connection to geothermal water, which enables whole year operation (www.slovakia.travel). According the research majority of respondents visited aqua parks in Slovakia (given by 119 respondents, which present 68% of answers).

Results

Slovakia belongs to the countries with the richest fresh ground water supplies in Europe. There are 1200 mineral and thermal springs in 600 localities (see Figure 1). Table 1 gives idea that due to the geothermal resources all aqua parks in Slovakia have year-long operation and they have mostly private ownership.

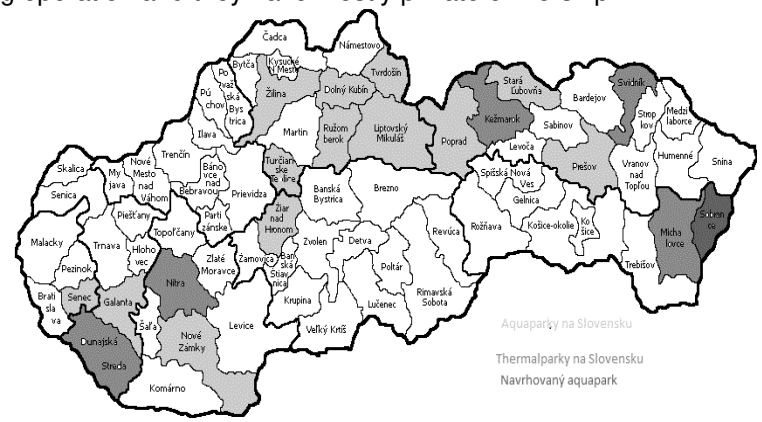

Fig. 1: Map with aqua parks in Slovakia
Source: own processing

Tab. 1: List of aqua parks in Slovakia

No	Name of aqua park	Operation	Ownership
1.	Tatralandia Liptovský Mikuláš	Year-long	Private
2.	Aquapark Senec	Year-long	Private
3.	Aquacity Poprad	Year-long	International, private
4.	Vodný raj Vyhne	Year-long	Private
5.	Holidaypark Kováčová	Year-long	Private
6.	Vadaš Štúrovo	Year-long	Private
7.	Spa & Aquapark Turčianske Teplice	Year-long	Private
8.	Vyšné Ružbachy	Year-long	Private
9.	Terchovec Terchová	Year-long	Private
10.	Oravice Meander Park	Year-long	Private
11.	Aquapark Delňa	Year-long	Private
12.	Gino Paradise Bešeňová	Year-long	Private
13.	Aquarelax Dolný Kubín	Year-long	Private
14.	Aquapark Termál Centrum Galandia	Year-long	Private
15.	Termálne kúpalisko Vrbov	Year-long	Private
16.	Thermal park Šírava	Year-long	Private
17.	Thermal Corvinus Veľký Meder	Year-long	Private
18.	Thermalpark Dunajská Streda	Year-long	Private
19.	Aquaruthenia Svidník	Year-long	Private
20.	Termálne kúpalisko Podhájska	Year-long	Private

Figure 2 illustrates prices for entry to various Slovakian and foreign aqua parks. Prices are calculated according actual currency in 2017 (www.kurz-euro.zones.sk).

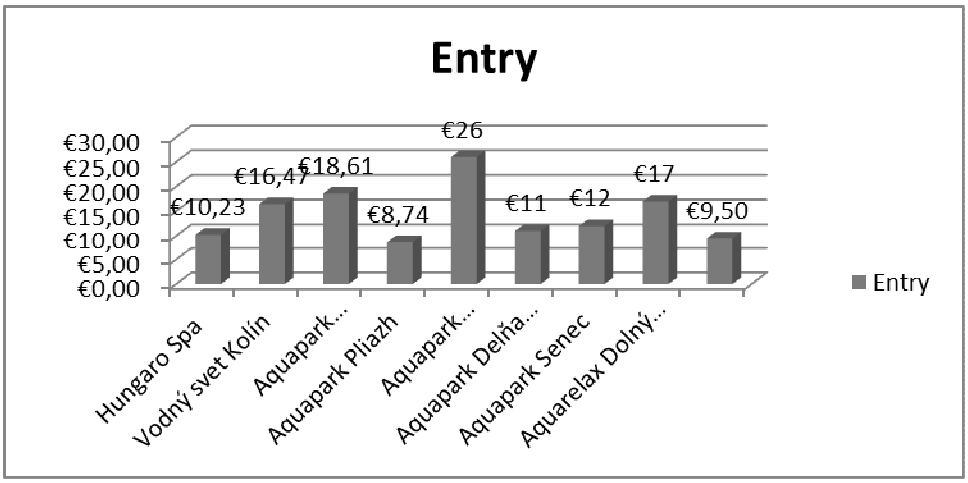

Fig. 2: Entry prices in different aqua parks (in €)

The detail information about individual aqua parks and thermal parks visits is given by Figure 3. Respondents answered as follows:

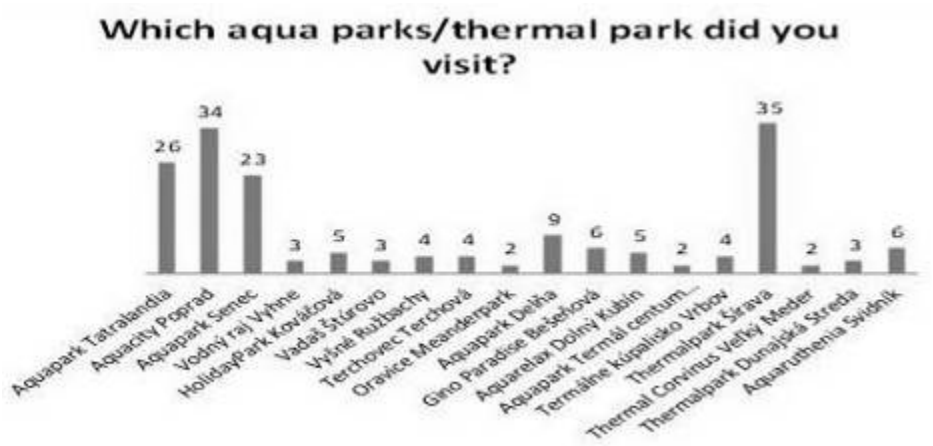

Fig. 3: Visits in individual aqua / thermal parks

Figure 3 illustrates the highest visits of aqua parks in Aquapark Tatralandia and Aquacity Poprad, which are famous also in abroad. High visitation had been recorded also in Thermal park Šírava, which is new and situated at the tourist lake, which is visited almost during whole summer. Through the research we found out that more women are visiting aqua parks in comparing with men. During the research we found also Slovakia has still other sources that can be used for aqua park tourism. Possible development presents establishment of thermal spa in village Sejkov in eastern part of Slovakia, which can be used for complex of open and covered swimming pools, during the winter. There is possible to realize also natural ice rink. By this way higher recreation value could be achieved, in comparing with single equipment using.

Conclusion

In Slovakia there is whole group of experience with geothermal or earth heat using, especially in aqua-park. But such using must be considered according tourist destination attractiveness. According the research Slovakia has in this area its attractiveness as tourist destination and aqua parks using in Slovakia, comparing with surrounding countries, has still sources that can be used for aqua park tourism. Possible development lies in establishment of further thermal spas in eastern part of Slovakia with aim to increase recreation value of aqua-parks.

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Souhrn
Sektor cestovního ruchu stále dostává pozornost a místo v národním hospodářství, ale je velmi citlivý vůči jakýmkoliv změnám na trhu. Turistika je často spojena s relaxací, sporty a rekreací. Tepelné zdroje země poskytují možnosti pro rekreaci a sport. Slovensko je bohaté na tepelné zdroje, proto je cílem příspěvku prozkoumat současný stav aquaparku na území Slovenska s následným návrhem na výstavbu nového aquaparku, který by mohl posílit hospodářský růst v regionu.

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PRINCIPLES OF THE STRUCTURE OF THE PARK STANDS FOR THE NEEDS OF HIGH RECREATIONAL COMFORT WHILE MAINTAINING THE BIODIVERSITY OF THE AREA

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Abstract

The structure of tree-stands, especially in large-area parks, has a direct impact on so-called recreational bio-climate. Obtaining such a goal is possible, if the stand reaches among others the optimal spatial, species and age structure. Thus the regulation of the park's stand over the years should strive to create sustainable, self-regulating systems, adapted to the leading function – recreation. The mature stands of large parks usually have a layered structure of vegetation and a specific age structure – both of high quality and ecological importance. An important feature of the stand is a degree of crowns closure – it affects the development of canopy and phytoclimate of the stand's interior. In terms of achieving high recreational comfort, the best qualities has a luminous stand - it is characterized by higher resistance to recreation movement, higher health and lush growth of trees, undergrowth more dense and resistant to trampling and at the end more favorable phyto-climatic conditions.

The aim of the article is to present the principles of shaping park stands for obtaining high recreational comfort and preservation of biodiversity. Theoretical assumptions were confirmed by field research conducted in 2013-2017 in the area of the ca. 600-hectare Silesia Park in Chorzów (Poland).

Key words: biodiversity, park's stand regulation, recreational bio-climate, Silesia Park

Introduction

Structure of park (especially large-area ones) tree-stands may, by analogy, be described in the same terms as forest tree-stands. Tree-stand structure includes spatial (vertical and horizontal) structure, species composition, age (of trees), health. However, unlike in case of forests where wood production requires adoption of specific management solutions (such as felling, replacement), the principal goal of park tree-stand management is shaping and maintaining it for widely defined recreational purposes (Janeczko 2011). Meeting this goal requires for park tree-stands to be made up of stable, self-regulating natural systems. A balanced approach to meeting this principal function - recreation while simultaneously maintaining biodiversity of a given area results in formation within and around park tree-stand of a desirable recreational bioclimate.

The goal of this publication is to present general guidelines of shaping park tree-stands for recreational purposes while maintaining biodiversity using an example of a reference site - approx. 600 ha Silesia Park in Chorzów (Poland), where authors conduced research into vegetation between 2013-2017.

Material and methods

In accordance with the goal of the paper, general park tree-stand shaping guidelines have been prepared with reference to its principal function - recreation - with special attention given to natural, spatial and cultural conditions. This part of research is based on literature review which is considered as one of the basic scientific tools (Cartwright 1965). Next, selected results of research conducted in the reference site - Silesia Park in Chorzów, Poland are presented. Park tree-stand evaluation included analysis of: species composition, spatial structure, age and general health. Basic measurements of representative trees were made and density and tree crown cover were estimated. In the final discussion research data is compared with theoretical data. Conclusions may be used as general guidelines for adapting park tree-stands to serve a recreational function.

Results

Park tree-stand structure vs. need for rest and recreation

Park tree-stand may significantly influence the **recreational bioclimate** - both inside but also in surrounding areas (Bartman 1974, Obmiński 1977, Prończuk 1982, Szymański 2000, Jaworski 2011). It is a sum of all natural variables the effect of which can be seen in air zone ("recreational layer") with a depth of ca. 2.0 m above ground level which is used for recreation. As a result, adaptation of park tree-stands for their principal function - recreation should be aimed at providing appropriate spatial structure which ensures improvement of among other: aeration, lightning and thermal conditions (Niemirski 1973, Bartman 1974, Obmiński 1977, Krzymowska-Kostrowicka 1997, Szymański 2000).

Enumerated guidelines may be relatively easily implemented by restructuring young tree-stands (up to 40 years old) characterised by inappropriate species composition and faulty spatial structure (such as excessive density and tree-crown cover). It is more challenging with older tree-stands, where getting similar effects requires more time. **The most beneficial form of tree-stand for high-traffic periodical recreation** (in daytime) is **a well-lit tree-stand with a loose tree-crown cover - in the range within 40-65%** (Niemirski 1973, Bartman 1974, Obmiński 1977, Siewniak 1990, Krzymowska-Kostrowicka 1997, Szymański 2000, Siewniak 2009, Jaworski 2011, Borowski et. al. 2016). Optimum sunlight exposition (both short and long wavelengths) of the bottom part of the tree-stand makes lightning conditions more advantageous for recreation - such as vitamin D_3 skin synthesis (Tomanek 1972, Obmiński 1977, Szymański 2000, Łukaszkiewicz 2008). In daytime ground is heated more and dries faster compared to a tree-stand with greater tree-crown cover which makes it easier to provide so called **thermal comfort** conditions for a lightly clothed human doing light physical activity (air temp. 21–22° C, air speed 10 m/s, air relative humidity 50%). Such conditions improve mood and are perfect for prolonged physical activity (Tyczka and Ponikowska 1983, Obmiński 1977, Krzymowska-Kostrowicka 1997, Szymański 2000). In a loose and well-lit tree-stand air relative humidity in the recreational layer is not excessively high (e.g. in a tree-stand with dense tree-crown cover it is up to 10% higher than in an open space). It allows sufficient aeration and a more favourable daily vertical movement of air (Tomanek 1972, Obmiński 1977, Szymański 2000) which has lower CO_2 concentration with better O_2 influx into the recreational layer – this reduces the effects of hypoxia present in a dense tree-stand (Tomanek 1972, Krzymowska–Kostrowicka 1997).

The final tree-stand form should feature a multi-layer structure (A: trees; B: underbush + saplings; C: undergrowth + seedlings), have a varied species composition and age structure. Well-lit tree-stands are **highly resistant to**

recreational traffic, have an undergrowth of high compactness and resistance to treading, and climactic conditions are more favourable for recreation. Trees growing with more light have lower slenderness ratios (s = h / d), live longer, flower and bear fruit more intensively and are more resistant to degradation (Niemirski 1973, Bartman 1974, Obmiński 1977, Szymański 2000, Wysocki and Sikorski 2009, Siewniak 2009, Jaworski 2011).

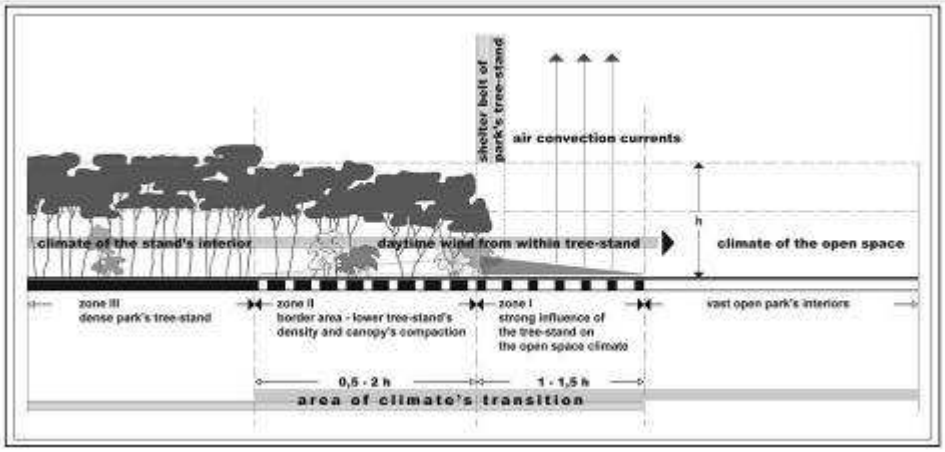

Fig. 1: Selected essential conditions for recreational bioclimate occurring in the border area of a dense, mature park's tree-stand (over 40 years old) vs. climate of open space and their interconnections (area of the climate's transition in zone I and II). System analysed in a vegetation period, S, SW, SE, W and E exposition (after Bartman 1974, Fig. P. Wiśniewski)

A specific recreational bioclimate is present in the **border region** of a park tree-stand, typically 5-10 tree height in width (Fig. 1.). Atmospheric air in this area is among other characterised by higher humidity, more active ionisation, higher oxygen and ozone saturation and less temperature variation. This is most pronounced in South expositions (SE, S, SW) and is connected with a phenomena of a so called "**daytime wind from within tree-stand**" which is present even in fine, windless summer days. This counteracts typical windless conditions and stifling effects for humans which is unfavourable for recreation. The phenomenon is caused by thermal differences between interior of the tree-stand and an open-space (Tomanek 1972, Bartman 1974, Obmiński 1977, Siewniak 1990, Krzymowska–Kostrowicka 1997). It forces vertical and horizontal movement of air from cooler areas (tree-stand interior) towards warmer areas (open-area). These can be observed mostly during vegetation period on fine days with weak wind.
Features of large park tree-stand border area make it **especially well suited for reconstruction and adaptation to both intensive and expansive recreation** (Fig. 2.). These are generally easily accessible areas located from S, SE, SW, E and W. Depending on needs and terrain the width of this area may reach up to 200 m. Resistant, recreational pasture type swards may be introduced in this strip. Open-area adjacent to the thick crown cover tree-stand border should include loose tree compositions and individual trees. Trees should cover no more than 20-30% of the area and should be placed perpendicularly to border of the dense crown cover tree-

stand. This will allow for free air movement towards open space (Tomanek 1972, Bartman 1974, Obmiński 1977, Siewniak 1990, Krzymowska–Kostrowicka 1997).

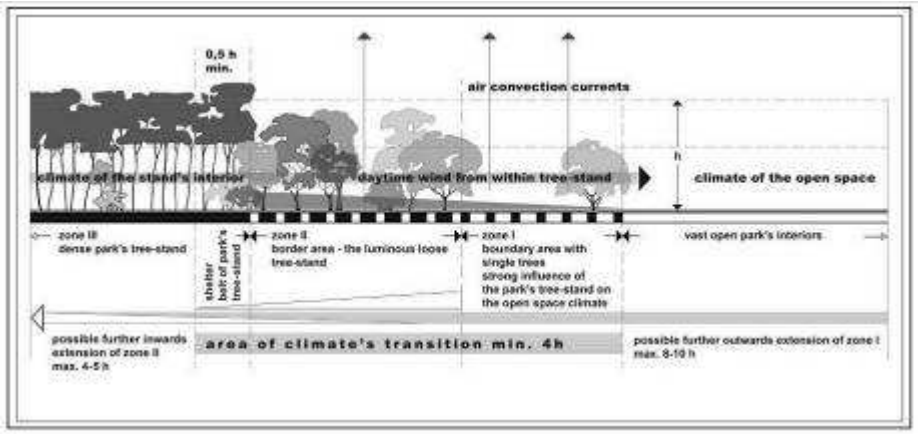

Fig. 2: The transformation and stimulation of climactic conditions and terrain recreation capacity after adaptation of a border zone of a dense, mature park's tree-stand over 40 years old (zone I and II) and its relation to an open area in vegetation period. S, SW, SE, W and E exposition (after Bartman 1974, Fig. P. Wiśniewski)

Silesia Park, Chorzów, Poland - tree-stand structure (case study)

Approx. 600 ha site established (1950-1968) in post-industrial and degraded areas in the centre of Silesia agglomeration. Park vegetation was shaped basically from ground up. **Western part** of the area with an intensive programme has a compositional layout with classical spatial forms (groups, flowerbeds, single trees) surrounding individual park interiors. **Eastern, extensive part** (larger, and at an elevation) is dominated by a dense crown cover tree-stand with a strongly varied and complex structure. Pioneering and fast growing tree-species have been used as forecrop (such as birch, aspen, larch, and in underbush: black cheery, dwarf willows, hazels, elder) to improve habitat conditions. Originally a grid of approx. 1.0×1.2 m (8333 pieces/ha) was planned. Authors envisioned reduction of the tree-stand area in favor of the extension of park interiors in the future (reduction of density to a average of approx. 4000 pieces/ha). The design foresaw reconstruction of the tree-stand at a later date - introducing final tree species (of more value) once temporary plantings reached their optimum development stage (Niemiec 1953). Since 80-ties of the 20th century maintenance of this part of the Park has been practically neglected.

Currently the tree-stand is predominantly made up of mature trees with a varied species compositions, varied crown cover density and tree habit: **A**/ some plots with a thin and correctly developed tree-stand - dendrometric parameters close to optimal parameters for park conditions, with sufficient slenderness ratio and static stability; single trees - with fully developed habits typical for their species, e.g.: mean tree height 23.0-25.0 m; spacing 5.0-7.5-9.0 m (10.0-17.0 m); crown cover approx. 70-80%; **B**/ plots with particularly dense crown cover - with a dense underbush and overtly developed trees with disturbed static stability; dendrometric parameters, e.g.: mean tree height up to 30.0 m; spacing 1.0-8.0 m [2.0-5.0 m]; crown cover up to 90%.

Secondary succession can be observed in the entire area, which left unattended in some areas results in among other excessive density (shading of lower tree-stand layer) and introduction of invasive species, as well as erosion of original spatial composition (e.g. diminishing of compositional axes and vistas, overgrowing of vegetation spatial forms). Effects of lack of the planned park interiors, which would ensure irregular tree-stand border supporting biodiversity (meadow communities) and recreational comfort (insolation) can be felt (Fortuna-Antoszkiewicz et. al. 2014).

Discussion

Results of literature analysis and field research beg the question whether adaptation of park tree-stand for recreational purposes is a threat to its biodiversity? Quoted research (e.g. Siewniak 1990, Krzymowska–Kostrowicka 1997, in.) shows that park tree-stand with a loose, non-schematic structure, adapted for purpose of increasing recreational comfort at the same time fulfils their environmental function well. Especially beneficial bioclimactic conditions and high biodiversity are present in border area of the tree-stand. Recreational capacity of such areas may be multiplied by skilfully shaping spatial structure and species composition of the vegetation (e.g. Niemirski 1973, Bartman 1974, others). The primary goal of **passive** biodiversity protection in parks may favour **undesirable effects**: maintaining tree-stands which are not beneficial environmentally (overtly dense, unstable and overdeveloped trees) and recreationally (unfavourable bioclimate), replacement of desired species by invasive ones, overgrowing of open meadow areas (park interiors) and additionally erosion of spatial compositions created precisely for the purpose of increasing recreational comfort (Fortuna-Antoszkiewicz et. al. 2014). Such circumstances seem to require an appropriate reconstruction and maintenance of large-area park tree-stands to maintain their desirable form and condition both for recreation and for stimulation of biodiversity.

Conclusion

- Tree-stands of large-area parks may feature a beneficial bioclimate for recreation, but its structure has to be **adequately shaped** with its primary function - recreation - in mind.
- Shaping of park tree-stands for greater recreational comfort does not exclude simultaneous protection of biodiversity, on the contrary - it may even **stimulate** it.
- Maintaining tree-stands of optimum quality (in terms of recreational comfort and maintaining actual biodiversity) in parks, especially in areas of heavy anthropogenic pressure, requires supporting activities such as **monitoring** of changes as well as sensible and planned **maintenance activities**

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Souhrn
Cílem článku je seznámit s principy tvarování parků pro získání vysokého rekreačního pohodlí a zachování biologické rozmanitosti. Teoretické předpoklady byly potvrzeny terénním výzkumem v letech 2013-2017 v oblasti cca. 600 ha Silesia Park v Chorzowě (Polsko).

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RECREATIONAL EFFECT EVALUATION OF REVITALIZATION ON RIVER PLEIßE IN GERMANY

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Abstract
Restoration of watercourses are made in order to restore to more natural form of technically modified rivers. It is therefore near-nature alterations because clearly natural form cannot be achieved. The article interprets the results of the application of the Recreational effect evaluation of watercourse adjustments of Lampartova (2015) on the selected area river Pleiße in Leipzig. This is one of the three main rivers in the city. The 2.7 km section, from the weir Elsterwehr to the curve in the floodplain forest Auewald, has achieved a high revitalizing effect. The final chapter of the article explains the significance of the results of the applied method in the chosen Pleiße section and appropriate recreational activities.

Key words: watercourses restoration, river Pleiße, recreation effect

Introduction

Rivers in cities are significant element. Cities were setting by rivers and now is concept understanding them as a part of natural environment in modern urbanism (Hrůza, 2002). Simultaneously river creates ideal opportunity to recreation (Aberg, Tapsell, 2013).

For recreation city Leipzig sets a good example. There are many green and blue areas able to use for citizens. Based on study Haase (2009) the change in forested area in Leipzig (since 1870) was not so big, there was decrease from 30 km^2 to 20 km^2. On the other hand, alluvial and riparian wetlands and grasslands were much more substantial (-6,8 km^2). Around the turn of the 19^{th} and 20^{th} Century city changed to compact industrial city. It caused that floodplains in the inner city to almost entirely disappear. Due to urban growth and land surfacing was noticed decrease in evapotranspiration fluxes of up to 25%, the direct runoff rates increased, groundwater recharge rates slightly decreased. From this we can conclude acceleration of water cycling through urban growth. But city keeps up with the times and suggest a lot of opportunities to rest.

River does not mean only river basin, in city are very significant banks. At the end of 20^{th} century were river banks cut off from public access (because of restaurants, clubs, police stations etc). For recreation is important river urban spaces be adaptive to promote all levels of connectivity (Kondolf, Pinto, 2017). Chen et all (2018) in their study stress importance of using public preferences to mobilize communication between civil society and decision-makers, and to guide the design of restoration schemes in the context of environmental governance. Specially to maximize social welfare and an effective management of urban river ecosystems can be achieved.

Materials and methods

For evaluation of chosen section river Pleiße in Leipzig has been used Evaluation method of the recreational effect of Lampartova (2015). This method has

multidimensional character – taking due account of aquatic ecosystem, flood control but also ecosystem services provided urban and suburban areas, like recreational, aesthetic or climate (Lampartova, Schneider, at all, 2016).
Method is determined to a single continuous homogenous part of a revitalised watercourse, of a minimum length of 100 m. The process of evaluating is based on evaluation of six indexes, their criteria and elements from a total of three areas: revitalisation, recreation and landscape. These areas are evaluated in relation to suitability of the landscape for recreation and recreation activities: tourism, recreation near water, water tourism, sport fishing, observation/photography. The resulting recreation effect is then assigned as low, average, high average and high (Lampartova, Schneider, et all, 2016).
Evaluation builds on a long-term research. This method was used for evaluating 26 rivers in cities in Czech Republic and also further foreign as Slovak republic, Spain, Norway and Germany. Concretely in Germany was evaluated chosen area of river Isar in Munich.

Characteristic of the selected area
City Leipzig is a municipality which lies at the confluence three main rivers: Pleiße, Weißer Elster and Parthe. Typical are for this city also small urban creeks. Thanks to these is in Leipzig rich river system. There is also significant Central European alluvial ecosystem.
River Pleiße spring in Drei-Linden-Brunnen in Ebersbrunn in Zwickau (443 m a.s.l.), flows to the north and in Leipzig entry to river Weißer Elster. Actual length is about 90 km (Verlauf der Pleiße, 2013). River meanders through floodplain forest Auewald. In terms of water quality river languishes. There was a discharge of wastewater from chemical industry that led to coloration, smell bad, excessive foaming and killing of aquatic fauna. Today is situation much better.
For evaluating was chosen section starting at the weir Elsterwehr and ending at the curve in the floodplain forest Auewald (you can see in fig. 1), total length of 2.7 km.

Results
For evaluation of the recreational effect on chosen area river Pleiße was used field diary, where were given point values to all elements in relation to recreational activities. Section achieves high recreational effect. Table 1 shows summary results.
Evaluated area is appropriate particularly for water tourism which is in Leipzig very popular (shows fig. 2 a). Optimal conditions are for canoeing or rafts. For cruise ship/boat are conditions suitable, no optimal, especially because of necessity low-submersibles motor boats for sailing under the low bridges. In Leipzig are differences in water level. This should facilitate a lock Connewitzer (fig. 2 b). Suitable conditions are also for walking, hiking and cycling. Paved roads lead on both banks and slowly moves to floodplain forest Auewald. In terms of bathing or wading are conditions less appropriate or inappropriate. It is mainly due to lack of gradual entry into the water, bad water quality and lower water temperature. For sunbathing and resting are river banks and surrounding area suitable. River and its surroundings offer suitable conditions for fishing, which is very popular, optimal conditions are then for observation of waterfowl, water animals and vegetation. Simple movement allow navigation and information panels both as for walking, cycling and water tourism.

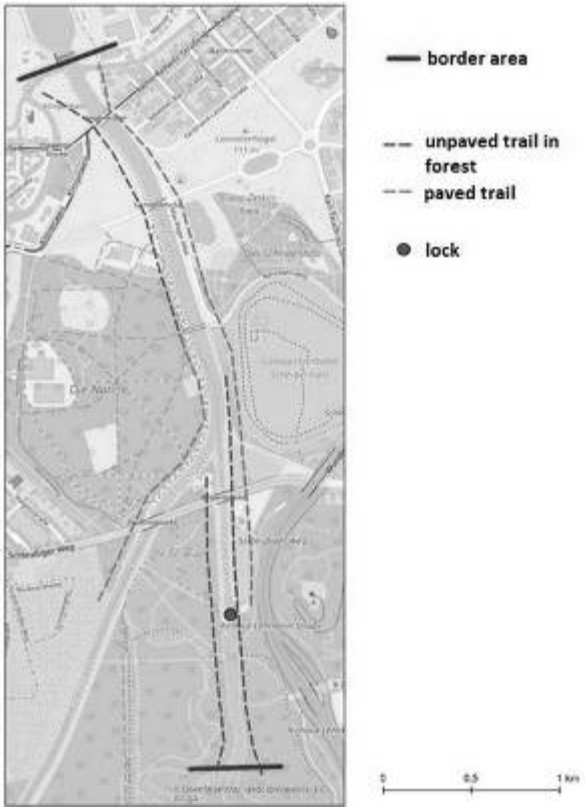

Fig. 1: Selected section of river Pleiße in Leipzig. From figure is noticeable view of fork- on left canal Elsteflutbett, on right river Pleiße. Figure edited in ArcMap.

Tab. 1: Summary results of evaluating recreational effect of chosen area rive Pleiße in Leipzig. Source: Kalasová, 2016

Evaluation indicators		Landscape suitabillity for recreation											
		Tourism				Water recreation			Water tourism	Sport fishing		Observation/photograp	
		Recreation activities											
		Hiking	Cycling	Ski	Hippo	Bathing	Wading	Sunbathing/resting	Canoe/raft	Motor vehicles	Fishing	Waterfowl/ water animals	Water/intertidal vegetation
Watercourse and its surroundings	1. Watercourse and flow path	0,10	0,10	0,10	0,10	0,49	0,34	0,00	0,74	0,57	0,50	0,43	0,43
	2. Circulation and visual adjustation of water quality	0,10	0,10	0,10	0,10	0,34	0,26	0,10	0,30	0,27	0,34	0,26	0,30
	3. Riverbed	0,00	0,00	0,00	0,00	0,00	0,50	0,00	0,27	0,42	0,20	0,25	0,38
	4. Bank and inundation area	2,03	2,10	1,98	2,28	0,76	0,71	2,05	0,83	0,83	0,96	1,15	1,43
Recreation	5. Social amenities existention and area accessibility	2,85	2,56	2,21	2,00	0,93	0,93	2,82	1,52	0,95	1,48	1,52	1,52
Landscape	6. Landscape element existention	0,57	0,42	0,38	0,35	0,13	0,13	0,60	0,38	0,38	0,15	0,15	0,15
B+B+K	Recreation activity sums ($RA = \sum U_1 + \sum U_2 + \ldots + \sum U_n$)	5,65	5,28	4,76	4,83	3,04	2,86	5,61	4,03	3,41	3,63	3,75	4,20
	Landsc. suitability to recr. ($VKpR = \sum KA_1 + \sum KA_2 + \ldots + \sum KA_n$)	20,51				11,51			7,44		3,63	7,92	
	Area sums ($1 - \sum VKpR_1 + \sum VKpR_2 + \ldots + \sum VKpR_n$)	51,00											

Fig. 2 a), b): a) Water tourism- very popular paddleboard, b) lock Connewitzer, yellow arrow shows on fish pass. Source: Lampartová, 2016

Discussion (v AJ)

Restoration impaired urban rivers in order to create supply of ecosystem services has received increasing attention (Viswanathan, Shimer, 2015). Well performed river restoration provide many social benefits, as enhanced quality of place, expanded tourism or diversified economic development opportunities (Johnson et all, 2018). Tourism in and around Leipzig plays a significant role. Very popular is also Markkleeberger See was remodelled from mining area. There is created sandy beach and is there very popular windsurfing.

Every river in Leipzig has different character. Especially its surrounding area, e.g. both banks river Weiße Elster have old industrial buildings reworked to apartments. City has very positive attitude towards shipping. There are many canoe/kayak rentals, which support tourism. As was already mentioned there was necessary to evolve special low-submersible motor boats. These boat is possible to order for a sightseeing tour. Also there are conducted school excursion on canoe/kayak with an explication involved in protecting environment. In Leipzig occurs e.g. protected kingfisher (*Alcedo atthis*).

Conclusion

In city Leipzig is combined urbanism and emphasis on the environment. City is woven river network. Every river has slightly different character. Evaluated area river Pleiße in Leipzig achieves high revitalizing effect. This section is optimal particularly for resting, cycling and walking. Despite of bad water quality are very poplar water sports in Leipzig. There are many canoe/kayak rentals. Due to low transit below bridges was necessary to evolve low-submersible motor boats. For bathing and wading are inappropriate conditions. Simple movement allow navigation and information panels.

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Souhrn
Článek prezentuje výsledky aplikace Metody hodnocení rekreačního efektu úprav vodních toků podle Lampartové (2015), a to na zvoleném úseku řeky Pleiße v Lipsku. Zvolený úsek začíná u jezu Elsterwehr a končí u zákruty v lužním lese Auewald, v délce 2,7 km. Výstupem metody je výčet vhodných rekreačních aktivit u zvoleného vodního toku a jeho přilehlého okolí.

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RECREATIONAL OPTIONS OF STRBSKE PLESO IN THE HIGH TATRAS FOR WHEELCHAIR PEOPLE

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Abstract
Hiking trails in Slovakia provide opportunities to perfect social inclusion of disabled people with potentially healthy people in friendly natural environment and rising their mental and physical balance. The article deals with the issue of tourist and recreational options for people with disabilities in a wheelchair, in a one of the highest recreational-tourist settlements in the High Tatras at altitude of 1,347 m. Proposed hiking trail with total length of 2.335 km is located in the center of top sport areal for nordic disciplines near the attractive Tatra lake Strbske Pleso in Tatras geomorphological unit. This natural lake is one of historic most significant and is second largest glacial lakes with an area of 19.67 hectares, maximum depth of 20.3 m and a water volume of 1,299,400 m^3. In the paper we present data and basic information about the lake, such as the localization, natural conditions, characteristics of trail etc. We quantify trail parameters, longitudinal profile, superelevations with altitude, the surface and obstacles on the trail etc. Stated data are intended serve to improve the accessibility of hiking trails for wheelchair people.

Key words: hiking trail, health tourism, wheelchair users, Tatra Mountains, Slovakia

Introduction

One way of improving the conditions for disabled people in wheelchair at national and supranational level is their inclusion is the development of tourism. Building recreational and educational trails without barriers is one of ways discovering of local traditions, history and natural beauty (Jakubisová 2014). Was processed data about this problems in the Report by Dr Margaret Chan, Director-General, World Health Organization. Results show how idividual technical help can get support and not ignoring the issue of wheelchair people. The importance of country leadership and community engagement is important in the performance of activities under individual level including the research activities.

Material and methods

Water areas are important component of recreational and touristic potential of the landscape (Jakubis 2013), the historical water reservoirs offer of possibilities for recreational, tourist and educational utilization (Jakubis 2014, 2016). The High Tatras and Strbske pleso (see Fig. 1) are a part of the Tatra National Park (TANAP), the oldest national park on the territory of our country. The High Tatras were from January 1, 1949 declared as an protected area of TANAP with area 738 km2 and together with buffer zone (around the TANAP) with 307 km2 occupy the territory 1,045 km2. Along with Polish part were declared in 1993 as Biosphere Reserve UNESCO. The High Tatras are the most popular area for leisure activities in our country. They are offer very wide range of leisure activities throughout the year, as in the summer, so also in the winter (Composite Authors 2014 in Jakubis 2015). They are primarily: hiking, mountain hiking, family hiking etc. The number and types of mountain actvities pursued by tourists have increased dramatically in recent years (Jakubis 2017).

The High Tatras the number of visitors increased from 186 visitors in year 1834 to 5 million visitors in the nineties years (Composite authors 2005). Exactly, we don´t have relevant data about the number of wheelchair people visitor in Tatras. In the Tatra National Park exists about 600 km of marked hiking trails and about 16 marked and maintained bike trails (Jakubis 2017). These highest mountains were also made available to disabled people, thanks to the State Forest of TANAP and the project "TATRY WITHOUT BARRIER". In the High Tatras is located more than 30 km of hiking trails for wheelchair people, also for people with other physically disability (Jakubisová 2016, Janeczko et al. 2016). Eight tourist trails (Tichá dolina, Popradské pleso, the canyon of Dunajec, Bielovodská dolina etc.) are available during the year.

Wheelchair accessible hiking trails are designed in the landscape for locations with favorable terrain configuration, with moderate slope and formed as a closed circuit with different length of routes, due to the variety of choice and demands of user. In Slovakia in terms of directional routing from the perspective of people with physical disabilities, the limits are not defined (minimum curve radius, tangential curvature path between curves of opposite direction, the length of straight lines and sight distance. Their propose is related to the current legislation that is not from the perspective of various disciplines compatible, is not united in Slovakia. All of elements must be selected to allowed smooth and safe movement both of hikers and wheelchair users. Usually, such trails are not separately designated only for one type of movement or also others users, for example cyclists (Jakubisová, Rollová 2017).

The criteria of touristic activities for wheelchair people in natural polygons we summarized on the based empirical experiences of wheelchair users: surface of the route should be in principle hard or reinforced; obstacles on the route (depth / height) should be < 8 cm (for electric wheelchairs is acceptable limit up to 10 cm); the maximum increase or decrease should not exceed 10% (for electric wheelchairs - max. 15%); the maximum length of the section with longitudinal gradient 10% - 15% should be < 150 m; ideal length of route should not exceed 4 km of the planned half-day activity; the maximum cross slope should be < 3% (for electric wheelchairs < 5%); maximum gradient at rest places for potential rotation of wheelchair users should be < 0,1%; minimum width for safe passage for wheelchairs should be > 90 cm; the minimum space for safe passage of two wheelchairs should be > 180 cm; space needed to rotation of the wheelchairs should be limited to a minimum diameter of circle = 1,500.00 mm. Data were derived from size of massive electric wheelchair-Orthopaedics-Tourning – 928 (Jakubisová 2014).

Results and Discussion

A summary of Strbske Pleso basic characteristics about access of wheelchair people are presented in Table 1 and 2. Total length of the proposed polygon is 2.335 km, which represents journey time in duration approximately 1.4 hours with wheelchair at speed of the movement of wheelchairs 1 km/0.6 h. Data of height differences and slopes of proposed trail are in Table 1 and longitudinal profile is listed in Figures 4-5. The lowest point of trail is 1350.80 m a. s. l. and highest point is 1365.69 m a. s. l. Maximum longitudinal slope is 9.21% between the points S38-S39 with length of 10,8 m. The maximum cross slope is 2.4 %. Maximum height/depth of obstaccles is to 0,08 m. There is a prevail compacted earth surface on the proposed route.Options of parking and accommodation for wheelchair people are listed in the Figures 2, 3.

Tab. 1: Strbske Pleso trail parameters (measured and calculated data)

No. ST	ST (km)	ALT (m a.s.l.)	DIST ALT (m)	DIST ST (m)	Max GRA (%)
S1	0.00000	1,357.20			
S2	0.05740	1,357.48	0.28	57.40	+0.49
S3	0.07850	1,357.56	0.08	21.10	+0.38
S4	0.13870	1,354.98	2.58	60.20	-4.29
S5	0.30190	1,355.65	0.67	163.20	+0.41
S6	0.49190	1,355.97	0.32	190.00	+0.17
S7	0.56900	1,354.26	1.71	77.10	-2.22
S8	0.59180	1,355.77	1.51	22.80	+6.65
S9	0.62060	1,354.87	0.90	28.80	-3.12
S10	0.64580	1,354.19	0.68	25.20	-2.70
S11	0.69430	1,352.79	1.40	48.50	-2.89
S12	0.71460	1,353.05	0.26	20.30	+1.28
S13	0.81670	1,354.21	1.16	102.10	+1.14
S14	0.85550	1,354.33	0.12	38.80	+0.31
S15	0.91940	1,352.78	1.55	63.90	-2.42
S16	0.98510	1,354.25	1.47	65.70	+2.24
S17	1.02960	1,355.78	1.53	44.47	+3.44
S18	1.04080	1,355.99	0.21	11.20	+1.88
S19	1.11170	1,355.62	0.37	70.90	-0.52
S20	1.22670	1,352.50	3.12	115.00	-2.71
S21	1.27850	1,350.80	1.70	51.80	-3.29
S22	1.29740	1,351.57	0.77	18.90	+4.10
S23	1.33740	1,353.37	1.80	40.00	+4.50
S24	1.40220	1,352.16	1.21	64.80	-1.87
S25	1.44130	1,353.48	1.32	39.10	+3.38
S26	1.50260	1,350.72	2,76	61.30	-4.50
S27	1.52950	1,350.41	0,31	26.90	-1.15
S28	1.55080	1,350.64	0.23	21.30	+1.08
S29	1.62890	1,353.28	2.64	78.10	+3.38
S30	1.65720	1,354.56	1,28	28.30	+4.52
S31	1.68890	1,356.38	1.82	31.70	+5.74
S32	1.72100	1,356.74	0.36	32.10	+1.12
S33	1.74120	1,357.03	0.29	20.20	+1.44
S34	1.76360	1,357.46	0.43	22.40	+1.92

			3.57	84.30	-4.23
S35	1.84790	1,353.89	1,94	28.50	+6.82
S36	1.87640	1,355.83	4.46	60.10	+7.42
S37	1.93650	1,360.29	2.39	30.70	+7.80
S38	1.96720	1,362.68	1.00	10.80	+9.21
S39	1.97800	1,363.68	2.01	63.60	+3.16
S40	2.04160	1,365.69	4.58	84.00	-5.45
S41	2.12560	1,361.11	1.33	26.50	+5.01
S42	2.15210	1,362.44	1.53	28.80	+5.31
S43	2.18090	1,363.97	0.41	28.00	+1.47
S44	2.20890	1,364.38	7.18	125.80	-5.71
S45≡E	2.33470	1,357.20		2,334.71	

Note to Table 1: No. ST-number station; S1-S45 – the order of ST stationing; ST (km) - stationing S1-S45 in kilometers; ALT (m a.s.l.) - altitudes in meters above sea level; DIST ALT(m) - differences of altitudes in meters; DIST ST (m) - distance between stations in meters; Max GRA (%) - maximum slope in percent; (+) - uphill gradient; (-) - downhill grade

Fig. 1: Localization of Strbske Pleso in map of Slovakia

Fig. 2: Options of parking and accommodation in the vicinity of Strbske Pleso

Fig. 3: Reserved Parking for Card holders with health disability (Author archive)

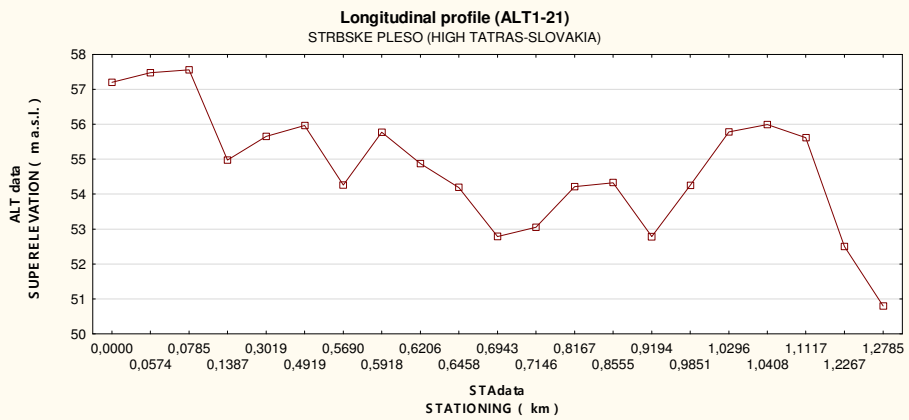

Fig. 4: Longitudinal profil of hiking trail Strbske Pleso (Altitude 1-21)

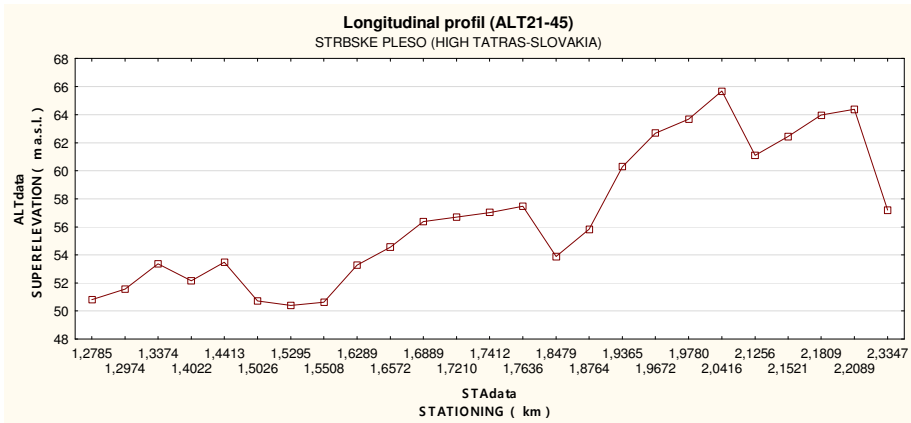

Fig. 5: Longitudinal profil of hiking trail Strbske Pleso (Altitude 21-45)

Tab. 2: The characteristics of Strbske Pleso to movement of wheelchair people

Summary of trail characteristics for wheelchair people:	Data
Total length of the trail:	2.335 km
Maximum longitudinal slope between stations S38-S39:	9.21 %
Range of up gradients (uphill):	(+) 0,17 – (+) 9.21 %
Range of down gradients (downhill):	(-) 0.52 – (-) 5.71 %
The maximum cross slope on the trail:	2.40 %
Max. height/depth of obstacles on the trail:	0.08 m
Estimated speed of wheelchair users:	1 km /0.6 h
Estimated time of the route without stops:	1.4 h

Conclusion

The High Tatras along with Strbske pleso are most famous and most visited places in Slovakia. They are a part of the Tatra National Park (TANAP), the oldest national park on the territory of our country. The aim of the article was propose new touristic trail to expand awareness of the possibilities of recreational and tourist activities in the surroundings of Lake Strbske Pleso in the Tatra National Park (TANAP) for wheelchair people. The proposed criteria of touristic trails with such purpose

polygons we summarized from empirical experiences of wheelchair users. The trail designed in the landscape with favorable terrain configuration, with moderate slope formed as a closed circuit. Their propose is related to the current legislation that is not from the perspective of various disciplines compatible,is not united in Slovakia.

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Souhrn

Článek se zabývá problematikou turistických a rekreačních možností pro vozíčkáře na novo navržené trase v oblasti Štrbského Plesa v Tatranském národním parku

(TANAP). Na turistickém chodníku jsme určili parametry trasy pro vozíčkáře: celkovou délku 2,335 km, rozestup stoupání (+) 0,17 - (+) 9,21 % a klesání (-) 0,52 - (-) 5,71 %, maximální příčný sklon 2,4 %, maximální výška/hloubka překážek 0,08 m, podélný sklon mezi body staničení, maximální podélný sklon (9,21 % na délce 10,8 m), povrch trasy atd. Mapovali jsme možnosti parkování a ubytování pro lidi na invalidních vozících. Navrhovaná kritéria přírodních polygonů turistických chodníků pro vozíčkáře jsou shrnutí na základě empirických zkušeností uživatelů invalidních vozíků. Turistická stezka je navržena na místě s příznivou konfigurací terénu s mírním sklonem a vytvořením uzavřeného okruhu. Návrh souvisí se současnou legislativou, která není na Slovensku z pohledu různých disciplín sjednocená.

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RESTORATION OF ACCUMULATION STORAGE OF SMALL WATER RESERVOIRS IN THE FOREST

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Abstract
Sedimentation processes can be observed on water reservoir, resulting in a gradual reduction of the total accumulation storage in the backwater area. In the year 2017, two project documentations were prepared for the existing small water reservoirs under the management of Lesy České republiky, s.p., involving the reconstruction of the dike, functional structures and restoration of the accumulation storage by the removal of sediment from the backwater area.

Key words: forest road, hydraulic structure, reconstruction, sediment

Introduction

Small water reservoirs (SWR) in forests are an integral part of our cultural landscape, they significantly contribute to the improvement of water quality in the river basin, they are of special importance as a source of water in areas with small watercourses and sparse hydrographic networks, part of biocentres, a refuge for animals and plants (Šinka and Kaletová, 2013). In small water reservoirs there are complex physical, chemical and biological processes influencing life in reservoirs, they decide on the quality of water and the possibilities of their usage. The most important physical processes include processes affecting the temperature changes in reservoirs and sedimentation processes (Pelikán et al., 2018). Sedimentation occurs in general all pond type reservoirs, resulting in siltation and diminishing the total accumulation space of the backwater area (Hanák et al., 2008, Kubinský et al., 2015). In the forest reservoirs, the siltation, besides the erosive wash from the basin, is applied very specifically from the fall of the leaves and the needles from the surrounding vegetation (Šlezingr et al., 2010).
Main activities of Lesy České republiky, s.p. (LCR) involve the management of more than 1.3 million ha of forests owned by the state (almost 86% of all forests in the Czech Republic) and care for more than 38 thousand km of designated watercourses and torrents and related hydraulic structures. Activities include the investment preparation of measures on small watercourses and small water reservoirs (SWR).
In cooperation with Jihlava Regional Directorate of LCR, in 2017, the authors of the article elaborated two project documentations for the existing SWR, the subject of which was mainly the reconstruction of the dam, functional structures and restoration of the accumulation space by the removal of the sediment from the backwater area.

Material and methods

The selected flow-through water reservoirs are located in the Vysočina Region - SWR Baba in the Hornosázavská pahorkatina (cadastral area Jedlá, Havlíčkův Brod, GPS 49.7315N, 15.2239E) and SWR Burianův rybník in Křižanovská vrchovina (cadastral area Domamil, Moravské Budějovice, GPS 49.0874N, 15.6622E). The reservoirs are situated in the stands of production forests, while the dam of Burianův rybník pond is part of the 2L Kopcova timber haul road and the

crown of earthen dam is equipped with a pavement made of unbound aggregate with unsealed road surface. At present, the technical condition of the two reservoirs can be characterized by the fact that a substantial part of the accumulation space is filled by sediments, the discharge device is functionless, the emergency spillway is non-capacitive or missing. The earthen dam is damaged, overgrown with bush and woody vegetation. In addition, the parameters of the dam of the Burianův rybník pond are inadequate for the safe passage of the logging truck-and-trailer unit (insufficient crown width). The design of pavement layers must take into account that the primary reason for the road reinforcement is the timber transport during which there are heavy pressures of the transport machinery axles on the road surfaces due to the weight of the transported timber (Hrůza, 2015).
The project documentation was prepared according to the valid technical standards (ČSN 75 2410, ČSN 73 6108) as single stage in the scope of the joint documentation for the decree the joint territorial decision and the building permit and build-up of the structure according to the decree no. 499/2006 Coll., on building documentation, in actual edition. The design documentation has incorporated the statements and requirements of the involved state administration bodies and the owners and administrators of the technical infrastructure networks.
Field survey included geodetic elevation and site surveying and engineering geological survey of sites aimed at determining the physical-mechanical properties of soils, their classification, assessment of suitability for building of earth structures and handling of extracted sediment.
The design and graphical part of documentation (drawings) was done in the ATLAS DMT 6 and AutoCAD Civil 3D 2018 software. Both programs work on the principle of creating a spatial model of a structure, related to a digital terrain model, made from geodetically surveyed data. The visualization of the reservoirs was developed in the Infraworks 2018 software for a more comprehensive presentation of the final concept.

Results

SWR Bába will be dealt with as one building part SO-01, in which the sediment will be extracted from the accumulation space, the shape of backwater area will be formed and the pools will be excavated on the right bank of the stream outside the reservoir. In addition, the dike repair will be carried out – removal of tree species, replenishment of the earthen body, including modification of slopes to the projected inclines and restoration of the water-side fortification. As a bottom outlet, a small prefabricated concrete structure with a simple sluice plank closing device and service foot bridge will be fitted. The outlet will be structurally connected to the existing outfall pipe DN 500. In the crown of the dike, the direct emergency spillway will be built with the discharge capacity designed for Q_{20} = 2.80 $m^3 \cdot s^{-1}$, fortified with a rockfill inside a circumferential concrete strip. The length of the overflow edge in the spillway bottom is 6.1 m with the proposed maximum overflowing jet height of 0.4 m.
Engineering project SWR Burianův rybník is divided into three building objects SO-01 Restoration of a small water reservoir, SO-02 Reconstruction of the timber haul road and SO-03 Measures for increasing the biodiversity of the site.
Realization of SO-01 involves sediment extraction from the backwater area, shaping the backwater area and grading banks. The entire earth body of the dam will be removed due to demolition of existing and construction of new functional structures (outlet and emergency spillway). A prefabricated concrete outlet with a double sluice plank closing device with a clay stemming and a service foot bridge will be newly

installed. The structure will act as the bottom outlet and manhole emergency spillway with the required overfall capacity of Q_{20} = 0.38 $m^3 \cdot s^{-1}$. The water will be conducted through the dike by new outfall steel pipe DN 600.
The dam of the water reservoir is located in the curve of an existing timber haul road with a radius R = 45 m. The new earthen dam is designed to be able to place a pavement with adequate bearing capacity and spatial layout in its crown. The waterward slope will be provided with a sealing clay layer and a foil to limit the penetration of water into the dike to the active subbase of the pavement where the effect of the load from the passage of logging truck-and-trailer unit is considered. The width of the pavement in the crown of 5.25 m was designed based on the calculation and regulations for the widening in curves according to ČSN 73 6108. The transverse slope of the pavement 3.0% was determined by the calculation based on the radius of the curve and the design speed of 20 $km \cdot h^{-1}$. The transverse slope was designed concentric towards the windward side of the dam in order to eliminate the centrifugal force applied to the vehicle when passing through a curve. The longitudinal gradient of the road is in the range of 1.0–4.0%. Pavement construction is 400 mm thick after compaction and consists of unsealed aggregate layers designed to be loaded by logging truck-and-trailer unit (design axle load 100 kN) – a deformation modulus on the 100 MPa pavement surfacing. Based on the physical-mechanical properties of the soil used for the construction and the results of the geological survey, the increasing the bearing capacity of the active subbase zone in the earthen dam, namely the gravel layer with particle size of 0/125.
As part of the restoration of the accumulation space of the reservoirs, 670 m^3 of sediment will be removed from the SWR Bába dam, respectively 715 m^3 from SWR Burianův rybník. Due to the parameters of the reservoirs, in both cases it is a cubature corresponding to approximately half of the total volume at the permanent storage water level.
The project documentation for both reservoirs has incorporated measures to increase biodiversity. The shapes of the reservoirs have been modified so that a part of the backwater area meets the conditions for the development of the littoral zone, as a zone of soft transition between the aquatic and terrestrial biotopes. The extent of the area with a depth <0.6 m is at SWR Bába 30% of the total surface area of the permanent storage water level M_s. Littoral represents 36% of the area M_s at SWR Burianův rybník.
The area adjacent to the reservoirs at the end of the backwater area can be hardly used for forest management because of the high level of groundwater, often reaching the surface of the terrain. In the case of both reservoirs, the excavation of pools, separated from the inflow and the water surface, was proposed. The designed pool on the right bank of the Bába stream has an area of 50 m^2 and a maximum depth of 1.0 m. Two pools with a total area of 180 m^2 with a maximum depth of 0.4 and 1.0 m will be excavated outside the reservoir Burianův rybník. Accommodation facilities for reptiles were designed in the vicinity of the pools. These will be constructed from stumps and branches coming from trees cut from the earthen dike and reservoir banks. Foundation the pools will allow existing amphibians to find a suitable biotope for survival during building-up of reservoirs.

Tab. 1: Designed reservoir parameters (75 0120)

	Water reservoir	
Parameter	**Bába**	**Burianův rybník**
Maximal water level $M_{rn} = M_{max}$	473.20 m n.m.	531.45 m n.m.
Permanent storage water level M_s	472.80 m n.m.	531.20 m n.m.
Bottom elevation	470.60 m n.m.	529.00 m n.m.
Water level area at $M_{rn} = M_{max}$	1780 m^2	1350 m^2
Water level area at M_s	1580 m^2	1210 m^2
Maximal volume V_{max}	1510 m^3	1218 m^3
Permanent storage volume V_s	1023 m^3	900 m^3
Area of the littoral zone (depth < 0.6 m)	475 m^2 (30% of M_s area)	435 m^2 (36% of M_s area)
Maximal depth of water at M_s	2.2 m	2.2 m
Average depth of water at M_s	0.95 m	1.0 m
Dike crest elevation	473.50 m n.m.	531.68–532.35 m n.m.
Dike length	46.42 m	40.00 m
Dike crest width	3.00 m	5.25 m
Required emergency spillway capacity	Q_{20} = 2.80 $m^3 \cdot s^{-1}$	Q_{20} = 0.38 $m^3 \cdot s^{-1}$

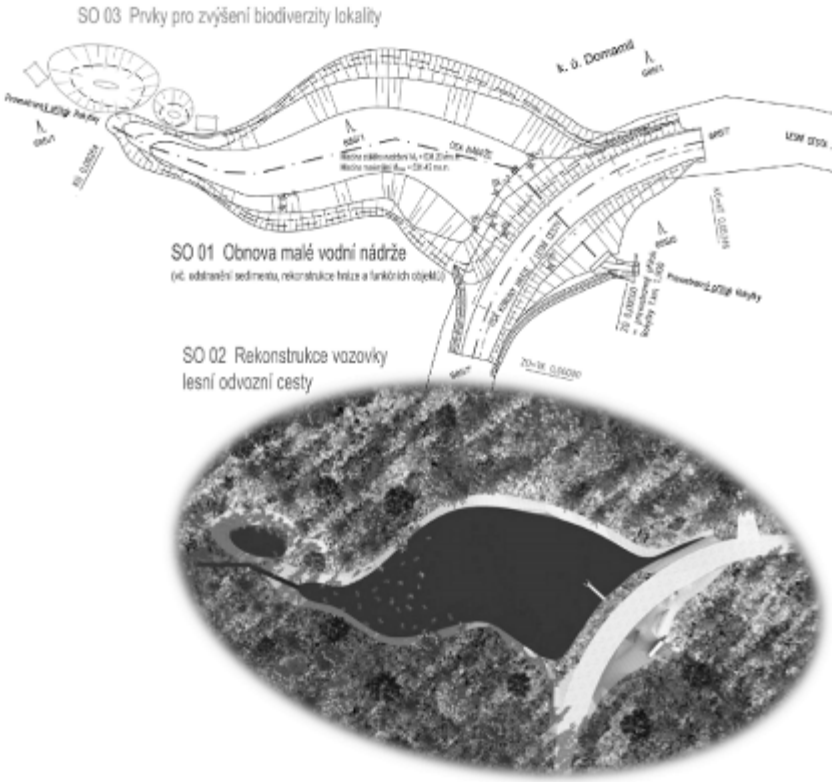

Fig. 1: Horizontal projection and visualisation of the Burianův rybník reservoir

Discussion

Hanák et al. states that the main water management problem of small water reservoirs is their siltation. One of the primary objectives of the above-mentioned activities was sediment excavation and restoring its accumulation space. The maximum efficiency and value of the investment costs incurred in the form of the maximum possible quantity of retained water in relation to the profile of the dam and the shape of the valleys could not be achieved due to the need to meet the littoral zone requirements with parameters strictly determined by the state authorities and organizations for nature and landscape protection. However, the exact value of the maximum depth of the littoral is not set in any mandatory document. A part of a water reservoir with a depth not exceeding 0.6 m is considered to be a littoral zone, which is a generally acknowledged natural boundary of the development of emery macrophytes in the direction from shorelines. Determining the specific value of a parameter is solved individually and depends only on the decision of the relevant state administration body. In practice, you can also meet a mandatory value of up to 0.4 m. At SWR Bába, a requirement to maintain a littoral area with a minimum of 20% of the level of M_s was established, but with a maximum depth of 0.50 m. The resulting area of the littoral considering a maximum depth of 0.60 m is even 30% of the level of M_s. For both reservoirs, relatively large shallow water areas were achieved compared to the overall parameters of the backwater area and it may act as an inefficient use of their overall accumulation space. In the long term point of view, it can be assumed that the reservoirs will once again be spontaneously silted with sediment, and the already large littoral will naturally increase.

Conclusion

Within the scope of the investment preparation of measures on small watercourses and small water reservoirs, project documentation was prepared for the existing SWR under the administration of Lesy ČR, s.p., whose object is the reconstruction of the dam, functional structures and restoration of the accumulation space by the removal of the sediment from the backwater area.

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Souhrn
V roce 2017 byly autory článku zpracovány projektové dokumentace ke dvěma stávajícím malým vodním nádržím ve správě podniku Lesy ČR, s.p., jejichž předmětem byla rekonstrukce hráze, funkčních objektů a obnova akumulačního prostoru odstraněním sedimentu z prostoru zátopy.

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SELECTED ASPECTS OF SILVER BIRCH SAP UTILISATION

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Abstract

The current fashion for a healthy lifestyle allows the promotion of many activities related to the forestry management. The forest environment, with relatively low level of chemicals use (especially in comparison with conventional agriculture), can provide a number of edible or medicinal goods and benefits, meeting even the most stringent standards (e.g. organic farming). One of these raw materials is birch sap. A growing interest in this product has been observed recently, formerly mostly imported, and now more and more often obtained from trees growing as well in forests and outside forests in Poland.

Commercial use of birch sap requires a scientific basis. Chemical research confirming the suitability of raw material for consumption is necessary, as well as natural and environmental research, concerning differences in the sap leak intensity depending on many factors. It is also necessary to develop the principles of sap collection, taking into account the impact of such activity on the natural environment, also from the point of view of landscape protection.

The article presents selected problems of obtaining birch sap in Poland. The literature in this field has been reviewed. Moreover, the case study results of the research on the impact of age of Silver birch trees on the intensity of the sap leak have been presented. It has been stated that the value of sap leak for 35-year-old trees was 3.6 liters per day, while for 80-year-olds - 4.7 liters per day. However, the differences were not statistically significant.

Key words: forest utilisation, non-wood forest products, tree secretions, Silver birch (*Betula pendula* Roth)

Introduction

The growing fashion for a healthy lifestyle results in the search for natural products coming from the least contaminated ecosystems, which are undoubtedly forests (especially compared with agricultural land). Products referring to the traditional use of the forest appear on the market more and more often - these are, for example, "coffee" from the acorns or flour for baking with the addition of ground acorns. One of the broader promotion of forest products is undoubtedly birch sap.

Birch sap is a clear, colorless and odorless liquid with a slightly sweet taste. Its production is connected root pressure in early spring, early when the water and the ingredients (mainly sugars, tannin, mineral salts and various elements) are transferred to the tree buds which develop leaves. The intensive period the juice flow takes an average of approx. 2-4 weeks; it depends mainly on climatic conditions. The birch starts to transport the juices upwards the tree crown when the temperature reaches for several days a value of 8-10° C.

Collecting of birch sap means creating small openings to a depth of a few centimeters. It is not harmful for the tree, it can only slightly decrease the technical quality of wood in the bottom part of the trunk. On the other hand, the raw material base, especially in the eastern part of Poland, would allow to obtain this raw material on a larger scale. Non-wood forest products, as natural and - as commonly understood - "ecological", can also be treated as an element of promotion of the regions they come from.

Use value of birch sap

Fresh birch sap consists mainly of water, reducing sugars (about 0.86%, including 0.50% glucose and 0.36% fructose), mineral salts (0.09%), tannins (0.26%) and organic acids (0.01%). Depending on the various factors, the sugar content may vary from 0.5% to 2%. The largest is at the beginning of the juice collection period. To a large extent it also depends on the height at which the juice is obtained: the higher we acquire it, the sweeter it will be, but also the lower the yield. Its specific gravity is 1.0045 G/cm3, the pH varies from 6 to 6.5, the energy value is 23kcal/100 ml (Grochowski 1990). Bilek, Stawarczyk et al. (2015) indicate that the average content of sugars in wood saps of selected species is: for a Hornbeam - 0.333 g/100 ml, for an Ashleaf maple - 1,109 g/100 ml, for Silver birch - 0.897 g/100 ml, for a White willow - 0.672 g/100 ml, for Downy birch - 0.475 g/100 ml, and for the Norway maple - 1.083 g/100 ml. The content of sugars in birch sap allows to consider the possibility of producing syrup. The literature presents data on the content of ingredients determining the possibility of industrial use of wood saps, mainly for the production of syrups: maple, birch and nut syrups. Wood saps have been tested for the presence of pro-health substances in them, including micro- and macro-elements and vitamins. One of the most important pro-health properties of wood saps is their antioxidant activity (Bilek et al., 2015). Among the mineral compounds, wood juices are mainly sources of copper and zinc, and therefore the decisive elements, among others about hormonal balance, body resistance, condition of the skin, hair and nails. One liter of wood juice, depending on the species, carries out the recommended daily intake for copper in an amount from several dozen to over 100% of the norm. The percentage of recommended daily intake with one liter of juice for zinc is from several to several dozen percent, depending on the species. The implementation of one liter of tree juice for nutritional norms for magnesium is regardless of the species several percent, while for the remaining minerals the implementation of nutritional standards is negligible, which is particularly significant in the case of sodium, as wood saps can be considered low-sodium raw materials, so much sought after in a modern nutrition model (Bilek, Stawarczyk et al., 2016). Research on the content of minerals in birch sap in the time profile does not allow to state that there is a moment when birch juice is characterized by more beneficial nutritional values, or that the variability of the mineral composition in the time profile is controlled by the relationships that are common to all the trees tested, where it would be necessary to base the procedures for obtaining juice for food processing (Bilek et al. 2017b). There was a large inter-individual variation in the content of the most valuable mineral components of birch sap, i.e. copper, zinc and manganese. It is therefore an important factor limiting the potential nutritional benefits, which is in turn important in processing. Correction of this effect is possible only by taking birch sap from as many trees as possible at the same time. This is only possible by obtaining juices from the forest environment (Bilek, Siembida et al. 2017). In addition, birch juice extracted from the forest areas

does not contain excessive amounts of heavy metals, residues of pesticides or polycyclic aromatic hydrocarbons (Bilek et al. 2017a).

Birch sap utilisation

Utilisation of birch sap was and is still popular especially in Eastern European countries (Russia, Belarus, Ukraine). In Russia, the extraction of juice dates back to the Middle Ages, until the 11th century it was the most popular drink in the country. There are no significant traditions in Poland for obtaining forest tree juice. In rural areas, the rural population used birch juices on a small scale in the 18th century, mainly in the eastern part of the country, in Mazovia and Podlasie. In the Kozienice forests, it was prepared with rye flour and milk, while in Kurpie, birch syrup was used as a sweetener (Svanberg et al. 2012). Way of obtaining it was by doing small incisions by an axe, then a stick was put on, along which the sap drained. Another, more developed method was the use of wooden or metal (in modern times) gutter, placed below the hole drilled to a depth of 2 - 5 cm. A bucket or other container was placed under the gutter into which juice was falling. One of the most effective and popular methods of obtaining sap is to use a tube (copper or stainless steel) inserted into a tree to a depth of approx. 2-3 cm without bark and a pipe attached to it, which brings the juice into a container placed on the ground. The tubes must not be driven too deep to ensure the flow from the conductive tissues. The length of pipes or gutters is 10 to 20 cm and depends on local customs. In the former USSR they used gutter made of birch or lime wood with a length of 16 - 18 cm. Often, glass tubes are also used for research purposes. The diameter of the tubes must be adapted to the diameter of the hole, which ranges from 5 to 11 mm (Kostroń 1974). The simplest, but also the least efficient way, sometimes used for personal use, is the attachment of a plastic bottle to the cut twig (Głowacki, Kalicka 2004).

Nowadays, it is recommended to obtain sap primarily in the stands planned for cutting down next year. You should choose trees with well-developed crown, but qualitatively weak, not to damage a potentially valuable timber raw material. The hole is made to a depth of 6-8 cm, not counting the thickness of the bark, a drill with a diameter of 10 mm, tilting them to the longitudinal axis of the trunk at an angle of 10° downwards. When the tree diameter at breast height (DBH) is from 18 to 25 cm it is recommended to make 1 hole, at the diameter of 26-35 cm - 2 holes, and at DBH over 35 cm - 3 holes. A tube is inserted into the drilled hole to a depth of about 1 cm. To connect the tube is located a flexible hose (eg silicone) that drips juice into the tank. After the leak has stopped, the holes should be secured with wooden, impregnated (eg with paraffin) studs (Głowacki, Kalicka 2004; Staniszewski 2011).

Intensity of birch sap leaking

According to various sources, one can acquire from 20 to 80 liters of juice on average per season, but maximum values can reach up to 200 l (Głowacki, Kalicka 2004). The average season lasts 2 - 3 weeks; in each of its stages, different efficiency of obtained juice is observed. Research conducted in the former USSR indicates that in the first half of the period, productivity increases with increasing temperature, whereas it decreases in the second half of the period when the temperature rises (Kostroń 1974). Literature gives different daily performance per one tree. According to Kostroń (1974), depending on DBH, the average daily output is 2.52 l for 16-20 cm thick, 3.14 l for 21-25 cm thick, 3.55 l for 26-30 cm thick trees. It was also shown that as the number of holes in the tree increases, the total yield from 1 tree increases. The efficiency of the juice also depends on the location

of the hole on the tree relative to the world side. Kostroń (1974) after Dinulescu (1968) states that the northern hole is most efficient, then the eastern hole and the west hole, while the southern hole has the lowest efficiency. These differences are quite significant, because the total production of tree sap with a hole on the north side was 275 l, on the western and eastern sides respectively 125 l and 169 l, while on the southern side 75 l of juice was obtained. An important parameter for the efficiency of obtaining tree juice is also the depth of the drilled hole. Research at the University of Michigan shows that in the case of a maple tree with holes with a depth of 7.62 cm gave 25% more juice than trees with holes of 5.08 cm. This is related to the increased surface of the wood vessels through which the juice flows, in the case of a deeper opening. Grochowski (1990) reports that the most efficient are 30- 40- year old birch stands, of which the highest productivity is characterized by trees with large DBH and dense, strongly developed crown. Still other sources indicate that the most efficient are birches at the age of about 15 years and this is the result of a small trunk diameter in relation to the crown. Research carried out at the University of Vermont has shown that the efficiency of trees with a reduced crown is comparable to that of trees with a healthy crown, and the reasons for different productivity should be rather in the tree roots and moisture of the soil (Sorkin 2014).

The influence of the age of the tree on the intensity of sap leakage - a case study

Currently, research is carried out on the variation in the intensity of birch sap leaking depending on a number of factors, including the age of trees, their biosocial position, the thickness of the trunk, and even the location of openings relative to the sides of the world. The results of research on the influence of the age of birches and the period during the sap harvesting season on the intensity of sap leakage are presented below. The research was carried out in the Garwolin Forest District (eastern part of Poland). Two tree stands of the same site type were chosen (moist broadleaved forest), where the dominant species was Silver birch, with different age (35 and 80 years). The Hartig method used to measure the volume of the trees according to thickness classes, where the stand is divided into three classes with the same cross-section area (Grochowski 1973), was used to select sample trees representing the stand. For the needs of the research, 2 sample trees were designated for each class, which gives the total number of 12 trees (6 for each age class). The holes (one on each tree) are about 5 cm deep and 1 cm in diameter, they were always located on the south side, at a height of about 1 m. It was determined that the sap leakage performance will be measured within 24 hours at weekly intervals. The first measurement took place on 11.03. and the last on 31. 03. 2017 (in total - 4 measurements). At the end of the sap harvesting season, the hole in each tree was plugged with a wooden pin, covered with a horticultural paste.

The intensity of the birch sap leakage was analyzed using two-way repeated measures ANOVA, which compares the mean differences between groups that have been split on two within-subjects factors (independent variables). The factors were: the age of the stand and the period (week number) during the sap harvesting season.

The results of studies on the dependence of the intensity of the sap leakage on the age of trees are shown in Fig. 1A. The average value for 35-year-old trees was 3.6 liters per day, while for 80-year-olds - 4.7 L/d. These differences were not statistically significant ($p = 0.480$), which was influenced by high variability of the juice leakage performance in both groups as well as the sample size (Osiak 2017).

Daily yield in the group of younger trees was in the range from 1.4 to 10.9 liters per day and in the older trees from 0.4 to 14.4 L/d. The very high value of the coefficient of variation in both groups amounted to 76.5 and 77.6%, respectively.
The analysis carried out in the time profile (Fig. 1B) did not confirm the significance of the differences between the sap leakage performance in 4 consecutive weeks of the sap harvesting season ($p = 0.252$), and thus the effect of repeated measurements was not demonstrated. There was also no interaction effect for both factors ($p = 0.590$), although it can be observed both in the group of younger and older trees that the productivity initially increased, reached its maximum, and then decreased in subsequent measurements (Fig. 1C).
These observations are confirmed by the multi-dimensional Wilks test ($p = 0.023$), however, based on the contrast analysis, it was not possible to clearly indicate the week (measurement) in which the sap leakage performance reaches the maximum, due to the high variability of this term even among trees from one stand; in general, thicker trees achieve maximum efficiency faster and obtain the higher values of this characteristic.
These results may suggest a relationship between the intensity of birch sap leaking and the biometric characteristics of trees, as well as the differences in the start and end dates of the sap leakage capacity and the length of this period even among trees growing in the same stand. However, these observations require confirmation on a larger empirical material.

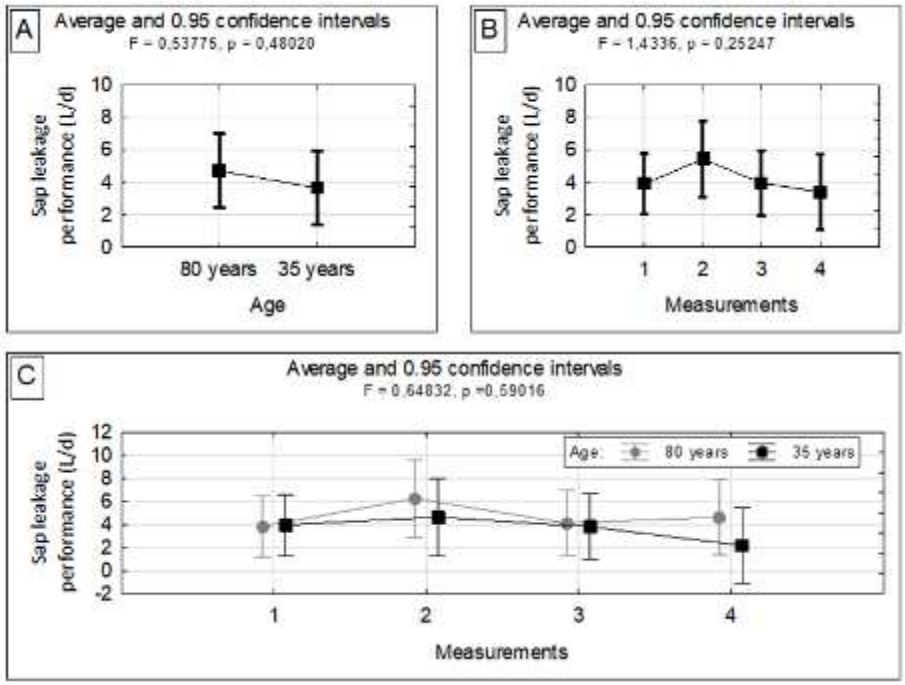

Fig. 1: Comparison of the average birch juice leakage performance (liters per day): A) between trees aged 35 and 80; B) during the following weeks of the sap harvesting season (measurement 1 - 11.03., measurement 2 - 18.03., measurement 3 - 25.03., measurement 4 - 31.03.2017); C) interactions between two factors: age and measurement

Summary and conclusions

Utilisation of silver birch sap seems to be the perspective direction of non-wood forest use. Its dietary and pro-healthy qualities have been confirmed, however, further research is needed regarding the differentiation of chemical composition and, consequently, utility values, depending on many factors. Based on the research already conducted, it can be concluded that the highest quality juice can be obtained from forest areas (Bilek et al. 2017a, Bilek, Siembida et al. 2017). From the point of view of forest management, the key problem is the development of rules for obtaining juice, and above all, access to trees and stands for juice intake, taking into account the conditionalities of forest management (the impact of obtaining juice on the technical quality of wood), forest protection, as well as landscape values of forest areas. It is also important to conduct extensive forest education in the area of non-wood forest utilisation, including exploitation of forest tree sap (Staniszewski et al. 2016).

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Souhrn
Článek představuje vybrané problémy při získávání břízy v Polsku. Literatura v této oblasti byla přezkoumána. Dále byly prezentovány výsledky případové studie vlivu věku stříbrných břízy na intenzitu úniku sep- tí. Bylo konstatováno, že hodnota úniku mýdla u 35letých stromů činila 3,6 litrů denně, zatímco u 80letých - 4,7 litrů denně. Rozdíly však nebyly statisticky významné.

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STABILIZING THE BANKS OF THE FLOODED SAND PIT

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Abstract
Stabilization of sand banks is very complex. We propose various forms of stabilization. We propose to modify the slope in several tilts.tilt. In addition, it is necessary to plant appropriate shrubs and trees.
At the bottom of the bank we propose different types of stabilization - this is the goal of the article presentation.

Key words: reed, reservoir, water, bank

Introduction

The basis for stabilizing the slope is its modification. We propose a technical, biotechnological or biological modification. If we consider tree species growing on banks, it is important to notice the effect of underground and aboveground parts. The root system grows through the soil profile and binds soil particles, thus reinforcing riverbed banks. Roots also grow into the zone of continuous flooding where they are a sought-after refuge for water fauna. (Kotásková et al, 2016) The aboveground parts of plants relieve the pressure of running water, protect banks against direct effects of waves, drifting of ice and in combination with nonliving reinforcing structures they act as long-term, durable and reliable stabilisation of banks. (Šmak et al, 2016) Protection against water flowing into the stream from adjacent land is very important, too. Banks may also be damaged in rainstorms when runoff is concentrated into one or more main currents, or when water flows back into the riverbed after overflowing onto the flood plain. (Šlezingr, Fialová, 2012, Kotásková et al, 2016)
By stabilising banks by means of grassland in combination with tree species, we can prevent riverbed banks from being damaged by erosion rills that can have a very unfavourable impact on the stability of riverbed slopes. (Galas, 2013)

Materials and methods

The article will focus on biotechnical stabilization. The technical element will be supported by appropriate vegetation.
Species for new planting shall be selected with a view to their future prevailing function, in particular taking into consideration whether they function as an accompanying stand (planting behind the riverbed bank line, on berm slopes as a maximum) or as a riparian stand (planting within the stabilisation of the riverbed and creating a direct relationship between the stand and the stream within the flow profile, on riverbed slopes). Or, especially in the case of smaller streams, a combination of both. (Kotásková, Hrůza, 2013, Pelikán et al, 2018)
Within the design of vegetation species structure, we should not forget shrubs, which have their indisputable place, and vital grassland, which is basic protection against the occurrence and development of erosion on the bank slope. (Harbuláková et al, 2016)

We propose in particular autochthonous species; other species only in special and justified cases. The planting of species unsuitable from the phytocoenological or landscaping point of view (exotic species, species more of collection importance...) may have a disturbing effect on the surrounding landscape.
On the Hulín reservoir we used tree trunks - see Fig. 1, On the modified bank (slope) Salix viminalis – see Fig. 2

Fig. 1: Stabilization of bank, Hulín reservoir (gravel pit)
(Photo M.Šlezingr 2016, adjustments in 2017)

Fig. 2: Stabilization planting – Salix viminalis, 2 rows under stabilization, 3 rows above technical stabilization (Photo M.Šlezingr 2017)

Results
The originál design - permeable breakwater, impermeable breakwaters (cross-section) – was not used. The resulting proposal (described above) has been implemented. (Šlezingr et al, 2010, Šlezinggr, 2016, Šlezingr, Fialová, 2012)

The basic result of the work is the reconstruction of the bank – the first variant. Subsequently, another research area will be built.

Conclusion

The article described one kind of stabilization. Biotechnical ways of stabilization – combinations of technical and biological stabilization elements. We may also use : fascine or fascine-gravel cylinders, woven fences, bands of rubble masonry with vegetation, etc, reinforcement by vegetation – mainly riparian stands of willow shrubs in the eulitoral zone, reed stands in the sublitoral zone, grass carpets, trees.

Next possibility – breakwaters - submerged, semi-submerged, and emerged breakwaters, permeable, impermeable, fixed, movable.

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Souhrn
V rámci řešení problematiky návrhu ochranných opatření na březích vodních toků a nádrží, se v představeném příspěvku zaměřujeme na stabilizaci břehů pískoven a štěrkoven. Zde se jedná o rozmyvatelný materiál břehu, poměrně málo úživný, kde je problém zajisti vhodnou dlouhodobou a účinnou stabilizaci. Z požadavků orgánů Životního prostředí vyplývá, že je třeba využít biologické, případně biotechnické stabilizace. Představujeme tedy jednu z možností biotechnické stabilizace navrženou a následně realizovanou na štěrkovně nedaleko Hulína. Jedná se o patu sesvahovaného břehu stabilizovanou kulatinou (obr. 1). Ta je ze strany návodní jištěna piloty, ze strany svahu pak zeminou osetou vhodnou travní směsí a osázenou několika řadami řízků Salix fluviatilis (obr. 2).
Stabilizace byla realizována v průběhu roků 2016, výsadby a výsevy pak na jaře roku 2017.

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SUSTAINABLE TRAILS AS SOLUTIONS FOR LAND MANAGEMENT

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Abstract
Providing sustainable recreational trails is one of the most effective ways how to manage the interface between silvicultural activities, nature protection and recreation. Trails can substantially decrease the problems arising from increased visitor numbers to forested nature areas. They do so in three main areas. They provide users with desirable experience, they establish visitor flows through landscapes and they provide effective risk management solution.

Key words: sustainable trails, trail planning and design, risk management, visitor management

Trails are a solution, not a problem

The combination of two recent trends make sustainable trail implementation a worthy solution in land management. In Central European societies a trend for higher volumes of short and more intensive visits to forest combines with what have been labelled a liability society - a social trend through which the responsibility has been shifted from the individual towards his / her surroundings and organisations that cater for it. In such circumstances the pressure on land managers, both forest managers and those responsible for nature protection is strong. Especially in heavily visited areas the restrictions work only to very limited degree and increasingly less so.

The problem is that land managers in Central European societies are not aware of the fact that visitors and liabilities can be managed through trails. Since the times of late 19th century when the development of sustainable recreational trails - especially in suburban forests - has been strong have long passed, since the craft of trail design and construction have largely disappeared and since the main public pressure to implement new trails is currently coming from mountain bikers – a group that is (perhaps falsely) deemed problematic, the solution that sustainable close to nature trails bring is currently only rarely considered.

In fact, the author of this article can confirm from his own professional experience that there is a tendency to turn down trail projects on the basis of assumption they will exacerbate precisely the problems they are able to solve if planned and designed professionally.

Additionally, there is still a widely shared belief among land managers based on the so-called wake theory (Kielwassertheorie) that the needs of the public for the route and ways infrastructure are sufficiently satisfied with the current forest road network as it is. This is based on lack of knowledge of the best practices in trail planning and design which if implemented with expertise and structure are in fact much more effective solution then passivity or restrictions. Providing sustainable trails gives an opportunity to land managers to navigate towards a modern approach that accepts recreation as part of their remit.

Trails have the exceptional capacity to serve as medium between users and the natural world and on that level, they define the quality of experience. Well-designed networks of sustainable recreational trails establish a flow of visitor through the forested nature areas, taking users when land managers want them to be and preventing them to visit sensitive or dangerous areas. Well planned and designed

recreational trails also provide an evidence on behalf of land managers that they do manage their liabilities proportionally to the qualities of nature areas they are responsible for.

Trails as a Medium for Forest Experiences

The idea that the experience of visitors to forests is defined not only by the qualities of the ecosystem but also by the infrastructure that they use for moving through it largely absent. It seems that majority of the responsible land managers around Central Europe are not appreciating the fact that forests are not experienced by bodyless souls but rather by visceral corporeal subjects that move around with legs (and bikes, skis or horses) which need a surface in front of them.

If you forget that visitors into forests move with their bodies, you might also forget that when they use current infrastructure, they are using forests roads not design for the pleasure of human movement but rather for the necessities of motorised forest management. While the existing forest road system does have a recreational function, it is far from the quality designed-for-purpose sustainable trails bring into equation.

If we accept that trails are a medium of forest experience we should also accept the broad parallel from media studies that “medium is message”. Clearly the experience is not communicated only by the forest itself but also by the infrastructure that visitors use for their movement. And if we want that experience to be desirable, the medium should be designed to transmit that experience. Professionally designed close-to-nature trails do just that, they immerse the users into the environment, bring flow to their visits and create experience users want to repeat. Sustainable trails communicate and intensify the emotions from forest experience, therefore creating loyal forest visitors. It is hard to appreciate the situation changed by proactive recreational trail provision in effect of which land managers start having emotionally attached users on their side.

Trails as a Tool for Visitor Management

Since design-for-purpose sustainable recreational trails provide users with higher quality experience from their visits to forested natural areas, users voluntarily choose to use them above the forest transportation network and / or heritage trails. This means that even in Central European countries with everyman’s right (right to roam, right of the way) in place that grants users their right to move freely as they wish, networks of sustainable trails provide effective visitor management tools. Even if some management techniques used elsewhere around the world are out of question (e.g. zoning, segregated use), systems of recreational trails channel forest visitors to corridors that are acceptable for land managers. As modern forestry and nature protection focuses on communications and relationships over directions and rules towards public the value of such effective non-restrictive visitor management cannot be overestimated.

Trails as a Tool for Risk Management

We have briefly established two important benefits that proactive implementation of sustainable recreational trails and trail system bring to forest managers. Firstly, they mediate experience and bring emotional attachment. Secondly, they offer effective non-restrictive visitor flow management.

Thirdly, they also provide solutions to manage liabilities, risk and hazard in increasingly risk-aware Central European societies. Although often coped with denial rather than problem-solving the liability society has arrived in forested

landscapes, the almost hysteric scare of the falling tree hazard (injuring visitors) being the proof.
Without acknowledging particular legal details and from general point of view the principles of liability in forested nature areas currently work are as follows:

1: There is always some level of duty of care lying with land managers
2: The duty is lowest for undeveloped land and highest for improved land.
3: The duty comes into play in situation where recreation interacts with other land functions, most often agriculture and forestry.
4: Trails are a form of improved land and a form of infrastructure and therefore they bring in risk management implications.
Since land managers in Central Europe generally cater for land whose elements have been developed, that has recreational (ways and route) infrastructure placed on itself and that hosts multiple functions, the fact that only rarely there have been clear risk management procedures and practices developed and applied shows certain professional deficit in the area. From practical point of view risk management practices and procedures can be best developed for new formally established sustainable recreational trails through what has been coined establishing the level of reasonable care. Such standard of care should take following factors in mind:

- there is a reduced scope for direct management intervention
- excessive stress on safety will damage visitor experience and demand costly modifications of infrastructure
- trail inspection and monitoring can be demanding and expensive it is necessary to aim to a level that can be maintained consistently over time in respect to financial and human resources
- there are other uses of nature / countryside / landscapes then recreation. Efforts to secure visitors‘ safety should not suppress these uses and functions.

In those countries where pro-active risk management in forest recreation provision is already practiced (U.S.A. and the UK) two established solutions exist. Firstly, managers demonstrate they are behaving as a reasonable person would under similar circumstances. Secondly, managers demonstrate they acted according to a defined standard of care or formally developed risk management program. The more formal the product, the higher standard is demanded.
To be able to prove any or both two land managers and entities involved with trails should break their approach down to a set of particular management measures.

- Trail design and construction standards
- Risk management team
- Emergency localisation system
- Informed decisions of visitors
- Warn against hazards
- Trail monitoring, inspections and record keeping
- Trail updates and closures

Applying the management measures needs to be balanced. On one hand they should demonstrate sufficient (= reasonable) standard of care on the other hand

they should not be so strict it will not be possible to maintain them consistently in time.
While elaborating on the above-mentioned risk management is beyond the scope of this article it is worthy to note that professionally prepared plan and design for the trail system and established risk management team are of special importance.
Having a clear standard for design and construction of trails is a fundamental component of trail network. In case of lawsuit it can be used to prove that the trail networks was designed and construction in sufficient quality and therefore protect designers, construction contractors, owners, operators and state authorities. In countries where trail construction is common (U.S.A. and the UK) over the years a good practice evolved that can serve as a basis for creating a project's own standard. In our experience it is advisable to break down trails into several categories and describe each of them on its own.
In well managed trail projects it became customary to create a risk management team during the period of preparation but at latest at the moment when trails become open to public. Risk management team is an executive tool that needs to be effective, proactive and systematic.
The team usually consist of representatives of project stakeholders. Its work lies in addressing the visitor safety issues on the basis of actual day-to-day experience. We advise the team to consist of persons with following competences: trail design and management expertise. trail operator‘s representative, land owner's representative (if different), health emergency or mountain rescue representative
The first task of the risk management team should be creating an emergency system for fast localisation of accidents and plan for approach routes for rescue personnel. The plan should be checked and revised at least once a year for changes both in trail and in approach infrastructure (usually the forest road network). Protocols and change logs need to be kept for record.
There should be a manual for trail monitoring and inspections. It is advisable that it is created by a trail designer who is knowledgeable of the desired state of trails. The manual should include the definitions of desired state, procedures for inspections and frequency for carrying them. All versions of the manual, former or current should be kept for record.

Conclusion

Land managers across Europe are not yet fully acquainted with the fact that providing professionally planned and designed sustainable trails solve three important and interwoven problems of theirs. Firstly, they build loyal users through emotionally charged experiences. Secondly, they offer non-restrictive visitor flow management and thirdly they provide solutions to manage liabilities, risk and hazard in increasingly risk-aware Central European societies.
The paper briefly summarized measures recommended to be taken in a trail relevant risk management. They should rely on having professional trail design and construction standards, establishing risk management team, designing and delivering emergency localisation system, providing conditions for visitors to take informed decisions on whether to participate in the activity that has inherent risk, warning against hazards, consistent monitoring and inspections of trails, and providing trail updates and closures information. When risk management gets broken down into these measures it can be managed simply and without substantial costs.
Although new sustainable recreational trails are sometimes seen as problem causing projects, they should be rather perceived as an opportunity for land

managers to navigate towards a modern approach that accepts recreation as integral part of their job.

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Souhrn

Realizace udržitelných přírodě blízkých rekreačních stezek je jedním z nejefektivnějších způsobů, jak spravovat styčné plochy mezi lesním hospodářství, ochrnou přírody a návštěvností lesnatých přírodních oblastí. Stezky dokáží podstatně snížit problémy vyvstávající ze stoupající návštěvnosti lesů. Činí tak zejména ve třech ohledech. Jednak uživatelům nabízejí atraktivní zážitky, jednak nastavají toky uživatelů územím a jednak zajišťují efektivní řešení preventivní povinnosti a správy rizik.

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TESTING THE VALIDITY OF BENEFIT TRANSFER IN CASE OF RECREATION VALUES OF NATURAL AREAS IN THE CZECH REPUBLIC

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Abstract
The contribution synthesises recreation demand values attributed to natural areas in Europe. We derive a measure of central tendency of European estimates from the published recreation studies in the past 35 years that were based on primary (individual) data. Since the estimates are substantially heterogeneous across the primary studies, we further disentangle factors of variability in reported values of consumer surplus per visitor per trip. A meta-analytic model is the core of the current analysis. The results show that the absolute in-sample errors of the model are relatively favourable and the model yields a range of estimates that may be employed for valuation of Czech areas.

Key words: value transfer, meta-analysis, recreation demand, recreation, open space

Introduction

The validity of benefit transfer in an international setting in general remains to large extent uncertain and needs to be tested. We focus on the synthesis of previous recreation demand research, which comprises primary studies that disentangle recreation use values associated with visits of individuals to natural areas, mainly forests, in Europe (including Czech Republic). The article is based on meta-analysis, which represents the most complex means of benefit transfer methods. The technique allows for synthesis of previous recreation demand research results and for testing hypotheses with respect to the effects of particular determinants of recreation use values of natural areas. Also, this technique facilitates validity testing - once the original estimate is available, to count the benefit transfer error which measures the accuracy of benefit transfer between primary and policy sites.
Based on the findings from our study that focuses specifically on recreation values in Europe, we provide a discussion that may empirically support the use of benefit transfer as an alternative approach to obtain primary estimates of recreation economic values for natural areas in the Czech Republic for which no primary estimates are available.

Material and methods

The meta-analysis includes primary environmental valuation studies that apply travel cost method (Parsons, 2003) and are employed to model forest recreation values across European countries. Relevant papers and studies were searched through databases such as EVRI, DEFRA UK and EPA US, further using the online research databases like ScienceDirect, JSTOR, EBSCO and peer review journals like Ecological Economics, Journal of Environmental Economics and Management, Environmental and Resource Economics. We have also reviewed EU funded projects that aimed at assessment of impacts upon non-market goods relevant for climate change (e.g. INTARESE, ClimateCost) and their monetary valuations (e.g. NEEDS, PASHMINA). These data sources were complemented by the grey literature (diploma and dissertation theses, working papers).

The final dataset consists of 394 observations (estimates) from 49 forest recreation studies published between years 1980 and 2013. Geographically, we identified studies from 15 European countries. The dataset covers Czech Republic, Denmark, Finland, France, Germany, Great Britain, Ireland, Italy, Netherlands, Poland, Romania, Slovakia, Spain, Switzerland and Turkey. One study reports on 1 to 30 welfare measures. Within these studies, several specifications of outcome measure were recorded (CS per visitor per day, per trip, per year; CS per population per year, including specification per 1 square kilometre of study site); for the model reported in this contribution, we focus on per visitor per trip specification of the consumer surplus (i. e. a monetary measure of recreation welfare associated with visits to natural areas).
The meta-analytic model is formalized as follows:

$$WTP_{ij} = SITE_{ij} + USER_{ij} + STUDY_{ij} + \varepsilon_{ij}$$

where:

WTP_{ij} .....is WTP estimate *i* from study *j*,
$SITE_{ij}$ .....is a vector of recreation site characteristics,
$USER_{ij}$ ....is a vector of socio-economic variables describing particular user population,
$STUDY_{ij}$ .is a vector of methodological variables characterizing study design,
ε_{ij} .....represents residual unobserved variability of WTP.

The *STUDY* vector also enables to widen the data set by including different valuation approaches such as in Bartczak et al. (2008), Shresta and Loomis (2001). The random error term then captures residual unobserved variability of WTP.
The particular explanatory variables were identified in the previous meta-analytic research in environmental economics, following the studies e. g. by Woodward and Wui (2001) and Ojea et al. (2010).

Results

Estimates of all consumer surplus specifications vary considerably among studies in Europe and there is strong evidence of outliers and positively skewed distribution of estimates. Consumer surplus per trip in European studies has a mean value of 42.8 and median 14 EUR.
Concerning the model specification, we considered pooled OLS, random and fixed effect models, with clustering at study level (following e. g. Zandersen and Tol, 2009). As the Breusch-Pagan Lagrange Multiplier test did not reject the null hypothesis of no within-cluster effect at α=0.05, the equal effect model is preferred over panel effects model and a pooled OLS model is employed (the same result is achieved when testing for other clustering structure - by author and by country). Table 1 shows the results of the meta-regression model. The final model is based only on variables that were significant at 5% level in the first stage of modelling, which included all variables available.

Tab. 1: Meta-regression - dependent variable: ln (CS per trip)

Variable type	Explanatory variables	T-value[1] (std. err.)[2]
	Constant	3.556***
		(0.374)
METHOD	Sample_size	0.000717***
		(0.000169)
	Estimate_preferred	0.177
		(0.113)
	Endostratification_corrected	1.321***
		(0.169)
	Endostratification_truncation_corrected	-2.477***
		(0.219)
	Representativity_regional	-0.120
		(0.278)
USER	GDP/CPT	-3.88e-05***
		(1.10e-05)
	Population_density_studysite	-0.00462***
		(0.000993)
	Specific_activity	3.156***
		(0.315)
SITE	Area	3.40e-06
		(3.54e-06)
	Broadleaved_%	0.0101***
		(0.00352)
	Defoliation_level	-0.0229***
		(0.00557)
	Observations	139
	No. of studies	8
	R-squared	0.81

[1]Robust standard errors in parentheses.
*[2]Significance levels: *** p<0.01, ** p<0.05, * p<0.1*

The resulting model captured 81 % of variability in CS per trip. The final variables included are the following:
STUDY variables: Sample size, Estimates preferred by the authors to draw the conclusions from the primary study (usually the best fitting or most advanced estimate of several estimates that the study typically offers), methodological variables on travel cost method (correction for endogeneous stratification and onsite truncation), regional (not local) representativeness.

USER variables: Population density in a perimeter around the study site, GDP per capita in market prices in NUTS2 region, Specific activity modelled (e. g. biking, hunting).
SITE variables: Area in hectares, % of broadleaved forest, defoliation level.
The methodological variables are the most important determinants and account for cca 50% variability of the recreation welfare. Interestingly, the model does not enable to directly link the CS per trip with the recreation site area; the area variable is not significant, which means that it seems there is practically no difference in welfare associated with a trip to a large forest and a trip to a forest of small size.

Discussion

The in-sample accuracy test seems to be promising: the mean absolute error over quartiles of data is 41% (median 29%). 75% predictions are associated with a transfer error lower than 50%. The error is relatively stable over different levels of CS per trip. The model, however tends to systematically overestimate very low values (mean error in the first quartile being +50%). The other quartiles of CS per trip exhibit average errors very close to zero (from -3% to +7%) which means that the errors for average and higher values of CS per trip are not systematically biased. The magnitude of transfer error is very/only weakly related to the original explanatory variables from the first phase of modelling.
According to Navrud and Ready (2007), the differences between the transferred value estimates and the values estimated at the policy site should be small enough to preserve reliability, for example around 20-40%. However, Brander et al. (2006) point out that for wetland ecosystem services, where the reporting of benefit transfer error is more extended than in forest benefit transfer studies, most of the meta-studies achieve a transfer error of cca 80%, which is considered acceptable in using the results of transfer as an input in wetland conservation decisions, when taking into account the high costs of performing new primary valuation studies. In this respect, our results are quite favourable.

Conclusion

The results demonstrate that the outcomes of primary studies focusing on estimation of recreation demand and values associated with open spaces and natural areas vary significantly across Europe. Recreation values of Czech sites fit well into the context and range of European estimates; the recreation values estimated for Czech pilot sites on different levels (local data on actual recreationists analyzed with a single site travel cost model in Kaprová, 2015a and 2015b; Melichar, 2012, versus a country-level data analyzed with a random utility model - Kaprová and Melichar, 2016) confirm this finding.
The results of the study also prove that benefit transfer of estimates from foreign studies across Europe, including Czech recreational areas, yields absolute transfer errors of cca 30-40 %, which is favourable according to the literature. This result holds when transferring values from the meta-analytic results of European studies to the Czech Republic; however, this approach has not yet been tested at a primary site out of the sample, where the errors may differ (and may be substantially larger if the evaluated recreation site differs from those in the sample). This issue would deserve a more in-depth discussion and will be addressed subsequently.
To conclude, we have proved that benefit transfer exercises may be employed as they represent a reasonably quick and acceptable way for obtaining recreation values for cost-benefit analyses. We would suggest their use mainly for minor prospective projects aimed at regeneration of recreational areas, where the

combined results from foreign estimates work relatively well for the transfer to the Czech sites in the sample. Also for evaluation of larger projects, the outputs of this contribution offer a range of primary estimates that are based on data describing the revealed (i. e. real past) behaviour of recreationists; here, there discussion on the validity and precision needed will be elaborated in depth in a subsequent study.

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Souhrn

Příspěvek se věnuje syntéze rekreačních hodnot přírodních území v Evropě. Odvozujeme míru centrální tendence evropských odhadů z odborných studií rekreační poptávky založených na mikroekonomických datech, které byly publikovány za posledních 35 let. Jelikož jsou výsledky jednotlivých studií značně

variabilní, vysvětlujeme variabilitu reportovaných hodnot s využitím meta-analytického modelu.
Validita mezinárodního přenosu hodnot je dosud značně diskutována a je nutné ji testovat. Meta-analýza, jakožto nejkomplexnější metoda přenosu hodnot umožňuje testování validity přenosu hodnot prostřednictvím výpočtu chyby přenosu hodnoty mezi místem původní studie a místem přenosu hodnoty. Dále tato metoda umožňuje testování hypotéz ohledně efektu jednotlivých determinant rekreační poptávky. Na základě výsledků diskutujeme, zda je přenos hodnot vhodnou alternativou k realizaci původních studií s originálními výsledky rekreačních hodnot pro dané rekreační území.

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THE IMPORTANCE OF PRO-ECOLOGICAL ATTITUDES FOR THE DEVELOPMENT OF SUSTAINABLE TOURISM

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Abstract
The changing trends in lifestyle and ways to relax have contributed to the introduction of the concept of sustainable development in tourism as well. It refers primarily to a form of tourism management that is characterized by understanding and knowledge of principles that include the nature, socio-cultural and economic aspects between which a balance must be maintained, guaranteeing long-term and harmonious development. Therefore, the basis of this concept is striving to achieve a balance between the needs of tourists, the natural environment and local communities. Therefore, it seems important to monitor changes in the attitudes and ecological awareness of inhabitants of areas used for tourism. The aim of the study is to determine the attitudes of the inhabitants of two counties in the Małopolska (Myślenicki and Nowy Targ) voivodship with respect to ecological issues and the pre-existence of their current state of ecological awareness. To achieve this, special categories were used: pro-ecological attitude and ecological indifference introduced into the literature by T. Burger. The results of the conducted research will be used to determine which behaviors of the inhabitants of the counties can be described as pro-ecological, and what are the manifestations of ecological indifference.

Key words: tourism, sustainable development, ecological knowledge, ecological attitudes

Introduction

The basis for the concept of sustainable tourism was undoubtedly the definition of the so-called responsible tourism, formulated in 1965 by W. Hetzer which distinguished four pillars, such as the minimization of interference in the natural environment, the respect for cultural differences, the maximization of the participation of the local population in tourist services, as well as the growth in satisfaction from tourism (Blamey 2001, p. 5-22; Kowalczyk 2010, p. 25-43). Over the years, sustainable tourism was defined by numerous authors, among others, by B. Lane (1994, pp. 102-111), R. W. Butler (1999, pp. 25-34) or D. Zaręba (2000). When analyzing the definitions of sustainable tourism, it turns out that it may be any form of tourism which is performed according to specific principles which are favorable to the natural environment and local communities (Nunkoo 2016, p. 277-285). According to UNWTO of 2004 (http://sdt.unwto.org, March 14, 2018): "Sustainable tourism development requires the informed participation of all relevant stakeholders, as well as strong political leadership to ensure wide participation and consensus building. Achieving sustainable tourism is a continuous process and it requires constant monitoring of impacts, introducing the necessary preventive and/or corrective measures whenever necessary. Sustainable tourism should also maintain a high level of tourist satisfaction and ensure a meaningful experience to the tourists, raising their awareness about sustainability issues and promoting sustainable tourism practices amongst them".

It should undoubtedly be pointed out that the idea of sustainable tourism comes from the principles of sustainable development because the basis of this concept results from the pursuit of balance between the needs of the tourists, the natural environment as well as the local communities (Gołemski 2002, pp. 368-374, Uglis, Jęczmyk 2015, p. 135-148). The development of such form of tourism is certainly related to ecological awareness which both the tourists and the local community should demonstrate. According to D. Zaręba (2008, pp. 31-39), this means the understanding and knowledge about mutual relationships between man and nature, anthropogenic hazards to the natural environment and the need to protect it, but also the affiliation to Nature and showing deep respect to Nature. It should be also be emphasized that the concept of sustainable development in tourism includes the economical, the ecological and the socio-cultural aspects. In fact, in the long run, tourism should become economically profitable for the local community, ecologically neutral and socially just. According to M. Kazimierczak, these three "pillars of sustainability" bind the tourist economy, the participants of tourism (tourists and the community accepting the tourists) as well as the destinations to which the tourists travel in a coherent whole (Kazimierczak 2009, p. 9-21).

At present, tourism is characterized by great dynamics of development and is one of the most important sections of the global economy. What is particularly important, its basis should be the pursuit of balance between the needs of the tourists, the natural environment as well as the local communities. It thus seems significant to monitor changes regarding the attitudes and the ecological awareness of the inhabitants of areas used for tourism.

In order to be able to characterize the state of the ecological awareness of the Polish society, T. Burger (2005, pp. 9-10) introduced special categories: pro-ecological attitude and ecological indifference. A pro-ecological attitude is presented by people who strongly opt for environmental protection, while people demonstrating the attitude of ecological indifference include:

- I a group favoring environmental protection, but not demonstrating a clear pro-ecological attitude,
- II a group of indifferent people, not interested in this topic and not feeling it necessary to deal with environmental protection;
- III a group of people seeing the problems of ecology, but believing that it is not the time to solve them yet;
- IV a group of conscious opponents of environmental protection.

The purpose of the presented study is to define the attitudes of the inhabitants of two counties in the Małopolskie Voivodship (Myślenice and Nowy Targ) regarding ecological topics, as well as to present their current state of ecological awareness. The above categories were used to achieve this aim: pro-ecological attitude and ecological indifference. The results of the conducted research will be used to determine which behavior of the inhabitants of the surveyed counties may be identified as pro-ecological, and which behavior is the symptom of ecological indifference.

Material and methods

The presented study is to distinguish the pro-ecological attitude and ecological indifference among the inhabitants of two counties: Myślenice and Nowy Targ. The research was carried out in 2017 on the sample of 150 adults with the use of a questionnaire. It included topics related to the level of ecological awareness of the respondents. When determining the attitudes of the inhabitants towards ecological

topics, an attempt was made to determine which behavior may be identified as pro-ecological, and which behavior is the symptom of ecological indifference.

Results

Non-ecological behavior, observed quite commonly in our country, is very often related to the fact that people are not aware of how much they contribute to the degradation of the environment with their everyday actions. The approach of the inhabitants of both surveyed counties to these topics should be considered ambiguous. On the one hand, they see the reprehensible behavior of their neighbors or other people from the vicinity but, on the other hand, they do not notice theirs - respectively 76% and 37% in both counties. The respondents pointed out various actions against the environment from their neighbors, such as: burning waste in furnaces or in gardens, discharging sewage into ditches and leaky cesspools, burning grass, storing unsecured asbestos tiles, using chemical sprays and artificial fertilizers.

It seems that the problem of the harmfulness of low emission is currently in the foreground when it comes to the ecological awareness of Poles. Burning low-quality fuel, harmful materials or waste in furnaces is lately much talked about everywhere. Unfortunately, the common social condemnation and campaigns raising awareness do not bring any large-scale effects, although minor changes in the people's awareness should be noticed. The vast majority of respondents (almost 87%) declared having knowledge in this field, although there were people who thought that the media were exaggerating the problem because "burning various things in furnaces is nothing new and people have done it for a long time". A group of almost 65% respondents declared that they were heating their houses with "good coal", eco-pea coal and wood, while almost one fifth of the respondents admitted buying coal of worse quality or even coal mud and coal flotation concentrate. It should not be surprising that the decisions in the latter case have purely economic grounds, and the respondents declared that if they could afford it, they certainly would choose fuel which was not harmful to people and the environment, or would change the heating method, e.g. to gas or electricity. Only single respondents answered that they would still choose their previous heating method, even if the prices of alternative heating methods were more favorable, stating, among others, that "all these campaigns are a conspiracy of the manufacturers of gas and coal companies".

The respondents recognized the production of healthy food and the conditions that should be met by a farm (Prus 2017) to be considered ecological a very important issue. Healthy food for them is, first of all, food which is produced without "chemistry", "without the use of preservatives" and "without artificial fertilizers". They described the conditions that should be met by a farm to be considered ecological in a similar manner. The respondents also mentioned not using pesticides on a farm, or the self-sufficiency of such farm in terms of crop cultivation and livestock breeding. Even though they knew perfectly well that the high doses of mineral fertilizers negatively affect the taste of food but, first of all, the health of the consumers, only two-thirds of the respondents declared frequently or occasionally using green fertilizers or compost on their parcels or farms, while the rest used only mineral fertilizers. The situation was slightly different in the case of chemical plant pesticides - approx. 76% of the respondents were aware of their negative impact on food. At the same time, the group of the supporters of such pesticides was quite considerable (19%).

The inhabitants of both counties declared that the majority of the households are connected to a sewage system, and the rest have cesspools. It is commonly known that the seeping of sewage into the soil can be very harmful and hazardous for people and animals, which was confirmed by the knowledge of the surveyed. However, this does not stop the neighbors (according to the respondents) from discharging sewage in different places. Although this does not apply to a large group of households (approx. 15% of the respondents pointed out this answer), it showed that sewage is still being discharged into ditches or streams in rural areas.
Another problem is the disposal of solid waste. Both examined counties organize selective municipal waste collection in which competent services pick up segregated waste from the inhabitants' property. These actions result in the fact that more than 70% of the respondents declared systematic segregation of waste, almost one fourth segregates waste occasionally, and only single persons admitted not doing anything in this area (this applies to people who answered "never" or "almost never"). The respondents from the last group justified the lack of waste segregation with the belief that the waste is not actually recovered again. Such answer could be considered positive in a sense, because it may suggest that the lack of actions in this respect does not result from laziness, but from the lack of awareness or knowledge what actions are undertaken in order to carry out secondary waste recovery. This is a signal for the local government that there is a need for educational campaigns which would make the inhabitants aware that the waste segregated by them is not stored on a landfill, but is actually recycled. This would probably increase the quantity of segregated waste. Another reason given by the respondents as one that makes segregation difficult, was the removal of appropriate waste containers. It seems that this is not entirely true, because companies picking up waste offer color bags for various types of waste for free which are then picked up with no additional fees.
The problem of waste disposal in the most unacceptable manner, namely by creating illegal dumping sites, may be observed by all of us. No respondent admitted to dumping waste in the shrubs or taking it to forests. However, when the question applied to people from the vicinity, the situation changed. According to the respondents, this does take place, and nearly half of the respondents concluded that it happens "very often" or "often", while almost 40% of the respondents believe that this happens "rarely" or "very rarely". The remaining respondents did not notice the problem.
Almost all respondents stated that the disposal of waste in such a way is improper, harmful and spoils the landscape, although there were several people who understood such behavior, even though they knew it was reprehensible - the main arguments were of an economic nature, related to high fees for the disposal of waste which the households needed to pay. What is particularly important, the majority of opponents of illegal dumping sites were convinced of the need to counteract this phenomenon. They saw a solution to this problem, among others, in high fines for people who do this, lower fees for the disposal of waste, making people aware of the harmfulness of such acts, as well as in the monitoring of the most often littered places.

Conclusion

The concept of sustainable tourism assumes the existence of a balance between the needs of the tourists, the natural environment as well as the local communities. It thus seems significant to monitor changes regarding the attitudes and the ecological awareness of the inhabitants of areas used for tourism.

The results of research conducted in the Myślenice and the Nowy Targ counties show that their inhabitants have a relatively high level of ecological awareness. The pro-ecological attitude is also prevalent, although it seems to be more declared than performed. A considerable part of the respondents is aware of the fact that they affect the environment with their everyday actions. The majority of respondents puts the responsibility for the condition of nature in their vicinity on the inhabitants, although they assess the behavior of their neighbors much more severely than their own. To sum up, it may be stated that we may speak rather about the presence of ecological indifference in the case of the inhabitants of both counties. According to the categories by T. Burger, they may be classified primarily to group I, namely the group favoring environmental protection, but not demonstrating a clear pro-ecological attitude, as well as to group II, namely indifferent people, not interested in this topic and not feeling it necessary to deal with environmental protection.

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Souhrn

Měnící se trendy v životním stylu a způsoby uvolnění přispěly k zavedení konceptu udržitelného rozvoje v cestovním ruchu. Jedná se především o formu řízení cestovního ruchu, které je charakterizováno porozuměním a znalostmi zásad, které zahrnují povahu, společensko-kulturní a ekonomické aspekty, mezi nimiž musí být udržována rovnováha, zaručující dlouhodobý a harmonický rozvoj. Základem této

koncepce je tedy snaha dosáhnout rovnováhy mezi potřebami turistů, přírodním prostředím a místními komunitami. Zdá se proto důležité sledovat změny v postojích a ekologickém povědomí obyvatel oblastí využívaných pro cestovní ruch. Cílem studie je stanovit postoje obyvatel dvou okresů v vojvodství Małopolska (Myślenicki a Nowy Targ) s ohledem na ekologické otázky a preexistenci jejich současného stavu ekologického povědomí. K tomu byly použity speciální kategorie: proekologický postoj a ekologická indiference zavedená do literatury T. Burgerem. Výsledky provedeného výzkumu budou použity k určení toho, které chování obyvatel okresů lze označit za proekologické a jaké jsou projevy ekologické lhostejnosti.

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THE INFLUENCE OF A SINGLETRAIL CONSTRUCTION ON THE SOIL PROFILE

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Abstract
This paper presents the results of a partial study of project "The effect of the SINGLETRAIL Moravian Karst construction and operation on the forestry management of Training Forest Enterprise Masaryk Forest Křtiny", which assesses the impact of the construction and operation of bike paths on the soil profile in terms of their humidity, compaction, and CO_2 accumulation. A large part of the bike paths of SINGLETRAIL Moravian Karst within the Training Forest Enterprise are designed to lead through spruce stands directly, in all their stages of development. The measurement of soil profiles was conducted at 4 sites and two series of measurements were carried out at each site for comparison of results; one series inside the stand 5 m away from the longitudinal axis of the bike path and the other in the line 10 to 20 cm away from the bike path formation. The measurements could not be done directly in the bike path formation due to the high compaction of its surface. Based on the data found, we can conclude that the soil profiles near the bike path formation, compared to the forest stand, manifested a lower humidity, higher compaction, and higher CO_2 concentration. By analogy, these conditions can be expected directly below the path formation. The above stated facts may impact not only the growth of the roots which are located near or just below the bike path, but also their water and nutrient supplies.

Key words: singletrail, humidity, compaction, CO_2 accumulation, soil

Introduction

If we disregard hiking as a sporting activity, typical sporting activities performed in the forest especially include jogging or running, cycling and mountain biking, horse riding and cross-country skiing in winter. Act no. 289/1995 Coll. on Forests (Forest Act), § 20 restricts activities such as cycling, horse riding, skiing or sledding to forest roads only. The vagueness of the term forest road has been fixed in the new standard ČSN 73 6108 Forest road network, as of 2016, which defines forest roads and divides them into two classes used to transport timber by hauling machinery. All the other transport routes in the forest serve for forest management operations as technological corridors for the harvest and hauling process, and sporting activities listed in the Forest Act law and directed to forest roads must not be done on them. This largely increases the concentration of visitors on forest roads and collisions may occur not only between visitors engaging in sporting activities and management activities in the forest, in this case timber hauling, but also between those who engage in different sporting activities. The likelihood of collision grows with the speed of the specific sporting activity. The authors addressing the issues of recreation in forest ecosystems (Lathrop 2003, White et al. 2006) agree that the most intensively expanding sporting activity in the forests is mountain biking. This leads to the requirement of this special interest group for the construction of special bicycle paths, so called singletrails, leading directly through forest stands.

An advantage of such a construction for forest owners or managers can be the concentration of forest visitors in the locations where collisions with management activities will be less likely. This brings more control over their activities as well as separation of various interest groups of forest visitors, for example, so as to avoid collisions between cyclists and the other forest visitors as the cycling is concentrated on special trails. However, the construction of the specialized trails for mountain bikes, singletrails, leading directly through the forest stand may impact the forest ecosystem. The subject of this article is to measure the impact of the construction and operation of singletrails on the soil profile in terms of its humidity, compaction and CO_2 accumulation.
Pickering et al. (2011) used the penetrometric method to identify the compaction of the soil profile when comparing the effects of mountain biking and hiking. According to their findings, mountain biking causes more damage only with a higher number of riders (500 or more). Goeft and Alder (2001) pointed out the compaction of soil, soil erosion and expansion of the bike path width as main effects of biking in the forest environment. The authors also emphasized the essential importance of bike path designing in the forest and the need for additional marking of critical bike path sections to increase the operational safety.

Methodology
The measurement was conducted on bike paths of the singletrail type within the territory of the Training Forest Enterprise Masaryk Forest Křtiny, which are contracted to the SINGLETRAIL Moravian Karst z.s. association. The starting point for these one-way trails is located near camp Olšovec, Jedovnice, where also technical facilities for the operation of the singletrails have been constructed. The existing three singletrails are made up of bike paths that go through the forest stand but also, partially, on forest roads. The total length is approximately 20.6 km, the length of the trails within the forest stand is approximately 16.1 km.
The measurement was done at 4 sites designated as Trail 1B, Trail 2, Trail 4, and Trail 5. Two series of measurements were carried out at each site for comparison of results; one series inside the stand 5 m away from the longitudinal axis of the bike path and the other in the line 10 to 20 cm away from the bike path formation. The measurements could not be done directly in the bike path formation due to the high compaction of its surface.
The humidity of the soil profile was measured by Delta-T HH2 moisture meter in the upper 10 cm of the soil profile, Fig. 1. Each series of measurement yielded five values, from which the arithmetic mean was calculated. Penetrometer Eijkelkamp with a penetration cone area of 2 cm2 and an angle of 60° was used to determine the penetration resistance of the soil. Each series consisted of five measurements into a depth of the soil profile 22 to 43 cm, Fig. 2. The measured values were used to calculate the mean curve directly in the penetrometer's program. The CO_2 concentration in the upper 10 cm of the soil profile was measured using Vaisala device with probes Carbocap, Fig. 1. The probes were inserted under the soil surface and the CO2 concentration values were taken about 5 min after the stabilization.

Results
Tab. 1 presents an overview of the results obtained. The values of the soil penetration resistance listed in the table were observed at a depth of 15 cm of the soil profile. The soil penetration resistance progresses within the profiles at individual sites are shown at Figs. 3 to 10. The values of the soil penetration

resistance were higher at all sites near the bike path compared to the free space within the stand - the difference was 77% on average (value increase span of 55% to 95%). The humidity measured near the bike path was lower than in the forest stand at all four sites, by 18.5% on average (value decrease span of 8% to 28%). The CO_2 concentration in the upper 10 cm of the soil profile at the bike path was many times higher compared to the soil profile in the stand. The values fluctuated from 2.2 to 4.6 multiple of the value found in the stand, the average was 3.4 multiple. According to the relevant literature (Güldner 2002), the level of CO_2 concentration in the soil profile is toxic for plants and micro-organisms at a value of 0.6% and more. This value is exceeded at two of the sites measured, Trail 1B and Trail 4.

Tab. 1: The values of soil penetration resistance, humidity, and CO2 concentration observed at measurement sites

			bike path	**forest stand**
Trail 1B	Soil penetration resistance	MPa	3,06	1,57
	Humidity	%	26,5	32,0
	CO_2	%	0,816	0,175
Trail 2	Soil penetration resistance	MPa	2,42	1,43
	Humidity	%	26,0	32,8
	CO_2	%	0,275	0,123
Trail 5	Soil penetration resistance	MPa	2,98	1,57
	Humidity	%	24,8	34,3
	CO_2	%	0,503	0,125
Trail 4	Soil penetration resistance	MPa	1,75	1,13
	Humidity	%	33,7	36,5
	CO_2	%	0,756	0,298

Fig. 1: CO2 concentration measurement (in the foreground) and humidity of the soil profile (in the background)

Fig. 2: Measurement of the soil penetration resistance

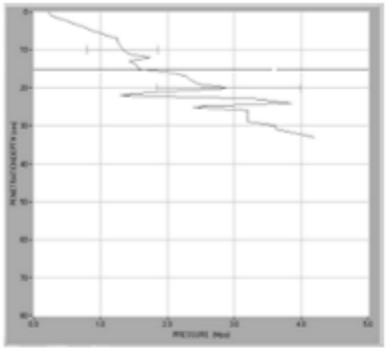

Fig. 3: Soil penetration resistance
Trail 1B, forest stand

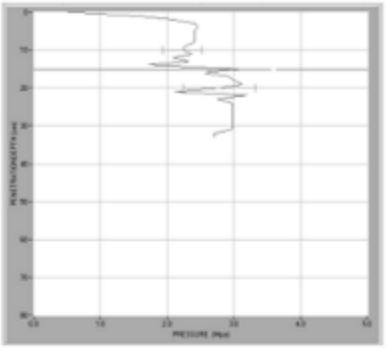

Fig. 4: Soil penetration resistance
Trail 1B, bike path

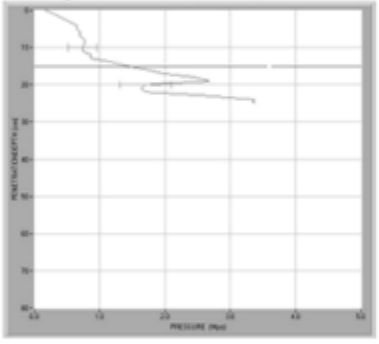

Fig. 5: Soil penetration resistance
Trail 2, forest stand

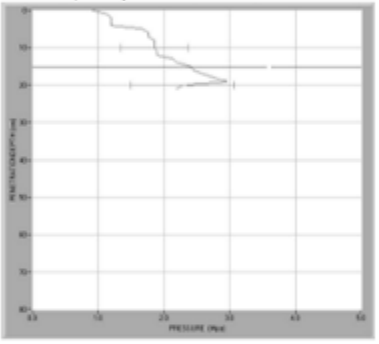

Fig. 6: Soil penetration resistance
Trail 2, bike path

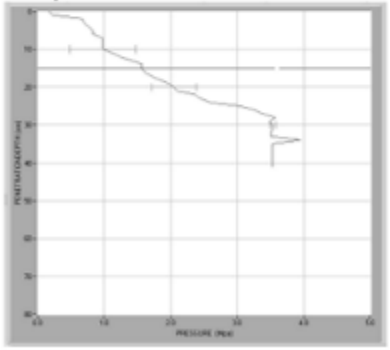

Fig. 7: Soil penetration resistance
Trail 5, forest stand

Fig. 8: Soil penetration resistance
Trail 5, bike path

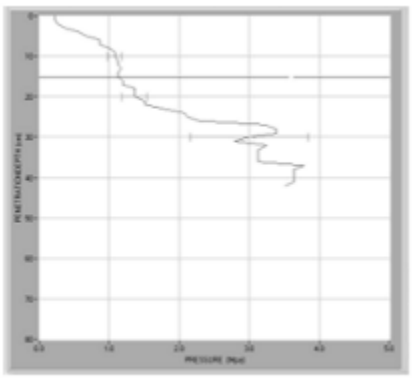

Fig. 9: Soil penetration resistance
Trail 4, forest stand

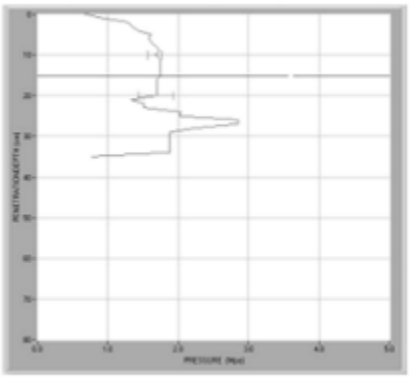

Fig. 10: Soil penetration resistance
Trail 4, bike path

Conclusion

Based on the data found, we can conclude that the soil profiles near the bike path formation, compared to the forest stand, manifested a lower humidity, higher compaction and higher CO_2 concentration. By analogy, these conditions can be expected directly below the path formation. The above stated facts negatively impact not only the growth of the roots which are located near or just below the bike path, but also their water and nutrient supplies.

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THE MINING VERSUS THE RECREATION – STUDY FROM ARMENIA

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Abstract
A consequence of the rapid exploitation in the Armenian's mineral resources has been a dramatic increase in the volume of mine tailings produced from the respective of mining/processing operations, and the subsequent impact of these tailing ponds/deposits upon the environment. The country's rural areas are being irrigated with water flowing from sources contaminated by mining operations laden with heavy metals, including mercury, arsenic and cadmium. This impact also decreases the potential of tourism development in the country full of nature beauties and culture-historical monuments. Moreover, there are many other negative impacts of mining on recreation possibilities, e.g. landscape degradation, air pollution, landscape scenery, biota contamination, etc. Our contribution is dealing with the impacts of mining on recreation potential in Armenia.

Key words: potential, impact, environment, metal

Introduction

The Republic of Armenia is located in the north-eastern part of the Armenian Plateau and occupies 29,740 km^2 at altitudes rating from 375 to 4095 meters above the sea level. Armenia is a mountainous country with a characteristic ragged relief and a wide variety of climatic conditions. Those physical conditions are a base for a lot of protected areas. According to the Law of the Republic of Armenia on Specially Protected Nature Areas (SPNA) (December 17, 1991) „Specially protected areas" are those territories of surface and ground waters, underground resources, flora and fauna, which are designated by the order determined by law and have special ecological, scientific, medicinal, cultural, esthetic value and entirely or partially, temporarily or permanently are not a subject to commercial exploitation (Khanjyan, 2004). Currently, there are 3 State Reserves/Strict Nature Reserves, 4 National Parks, 27 Sanctuaries/State Reservations and 230 Nature Monuments. Totally app. 14 % of the territory (Novanska, Geghamyan, 2017).

The Republic of Armenia is well-know also by its tourism attractiveness. Numerous monuments and masterpieces of the Ancient era and Middle Ages can be found throughout the country. Tourism in Armenia is rooted in the country's historical landmarks and natural attractions such as the water resorts of Lake Sevan, the hot springs of Arzni and Jermuk, the forests of Dilijan, Aghveran, Tsaghkadzor, Bjurakan and Gugark, and the mountainous natural caves and cliffs of the Southeast region. (www.nationsonline.org).

On the other hand, the Republic of Armenia is a country full of mineral metals (Figure 1.) e.g. iron, copper, molybdenum, gold, lead, zinc, aluminum. Armenian mining sector is one of the most important sectors of the national economy according to financial contributions, foreign investor input, rural employment (WB, 2016). Between 2003 and 2013, there were 413 "non-metal" mines and 26 "metal" mines in Armenia with granted exploitation rights. It is important to declare that some of them (6 metal mines) were located in the area with the huge share of culture heritage (Nazaryan, 2013).

In this contribution, we focus on the mining-tourism-recreation triangle, as a means of exploring how can the massive mining industry influence the development of recreation in Armenia.

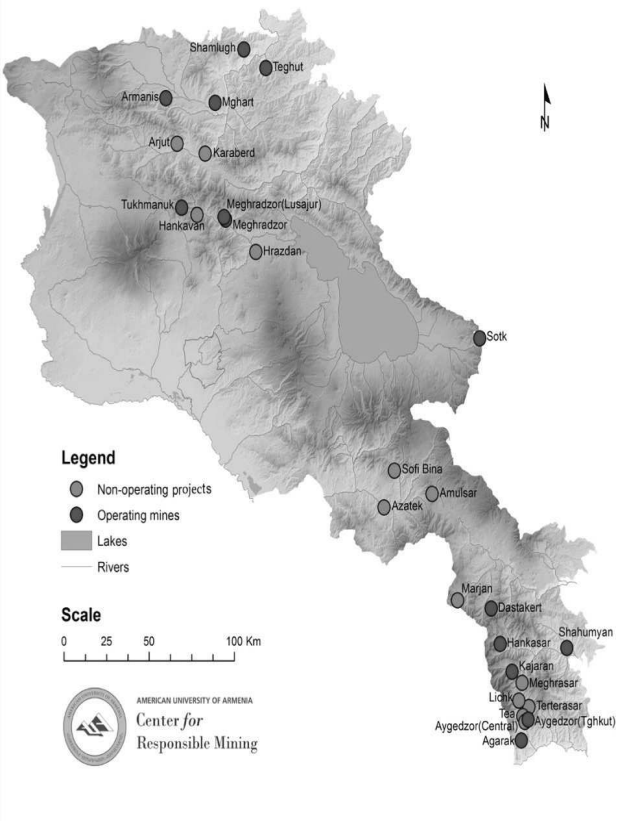

Fig. 1: Metal mining projects in Armenia. Source. WB, 2016

Material and methods

The main methodological approach of our study is a prediction of expected impacts asserted in the frame of impact assessment methodology. Evaluated impacts were typed into common groups and importance was set up:

In the first step as:

0 – No impact (proposed activity does not affect environmental elements, human body, landscape in any manner)

1 – Non-important = very small significant impact (impacts with a character of risk, accident or with a minor effect or contribution)

2 – Small important (an impact which effect is from the quantitative point of view low, local and the receptivity is low)

3 – Important (it reaches broaden area, the receptivity is high)

4 – Very important (the receptivity is high till very high)

In the second step were weight added for groups of impacts:

- Impacts on abiotic environment:2,00
- Impacts on biotic environment: 3,00
- Impacts on the landscape: 3,00

- Impacts on protected areas: 3,00
- Impacts on human bodies and social-economic activities: 4,00
- Impacts on the infrastructure and land-use: 5, 00.

The values of weights were determined on the basis of:
- overall nature of affected areas from the point of view of representation and vulnerability of natural and landscape elements and localization of the activity
- population size in affected area and a concentration of human bodies
- an importance and a gain of the activity from the point of view of economic and sociable development of a region.

Results and discussion

The evaluation of impacts of mining activities on the recreational potential should analyze various aspects of the environment, should take into consideration all possible changes of the environment which in its turn can affect nature and people. It is crucial the assessment of all impacts in different contexts: cumulative, indirect (direct), reversible (irreversible) etc.

Extraction of minerals and metals (including metalloids and rare earth) from the Earth's lithosphere by human has resulted in large scale and extensive pollution of the environments (Gu, 2018). Environmental impacts from mining activities (whether large-scale or small-scale) can be very hazardous, dangerous for health, but decision-making is rarely guided by environmental issues (Spiegel, 2017).

Regarding the potential impact on the environment, the development of mining projects has certain peculiarities compared to other projects. The environmental and social impacts are diverse and sometimes have long term impact on the environment (Christmann et al., 2007).

The expected impacts of the mining are the basis for the study. This is evidenced by the evaluation presented in the table no. 1. It should be emphasized that the assessment is made considering the possibilities of developing recreation, not on the environment as a whole. That is a reason while the weight of the social-economic sphere is so high.

Tab. 1: Impact evaluation

Impacts on:	Weight	Importance	Resulted evaluation	Importance	Resulted evaluation
		During operating		During closing	
Impacts on abiotic environment:	2	- 4,0	- 8,0	- 1	- 2
Impacts on biotic environment:	3	- 2,0	- 6,0	- 2,0	- 6,0
Impacts on the landscape	3	- 3,0	- 9,0	- 3,0	- 9,0
Impacts on protected areas	3	- 3,0	- 9,0	- 2,0	- 6,0
Impacts on human bodies and social-economic activities	4	- 2,0	- 8,0	- 2,0	- 8,0
Impacts on the infrastructure and land-use	5	- 2,0	- 10,0	- 2,0	- 10,0

As we considered, the influence of mining activities on the recreation is negative, the most impacts are long-lasting, which persist even after mining is closed, especially impacts on the landscape.
In addition to direct impacts as land use change, emissions to air and water are, there are also significant secondary impacts, among which we should predict the impact of predominantly rural areas on water, animal and vegetation by heavy metals. All this affects the quality of human bodies life in this area and the development of recreation.

Conclusion
As can be expected, the outcome of our assessment is the negative impact of mining on the development of recreation, especially long-time impacts, which cannot be mitigated. But we do not want to end this negatively. Nowadays, there are many new types of tourism that can help to reconstruct such territories as open quarries. And just new geotourism projects could serve such intent in the future.

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Souhrn
Arménie je země plná přírodního a kulturně-historického bohatství, ale zároveň země, kde je jedním z hlavních ekonomických odvětví hornictví, speciální těžba kovů. To s sebou přináší i působení mnoha negativních jevů na životní prostředí, což může ovlivnit rekreační potenciál s tím spojený rozvoj rekreace v zemi. Kromě přímých vlivů jako jsou narušení horninového prostředí, zábor půdy, změna využití krajiny, emise do ovzduší a do vod, jsou zde i významné sekundární vlivy, mezi nimiž musíme zejména počítat ovlivnění převážně venkovského území kontaminací vod, živočišstva a vegetace těžkými kovy. To vše ovlivňuje i život člověka v tomto území a rozvoj rekreace.

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THE ORCHARD FLOOR REACHES DESIRED BIODIVERSITY THREE YEARS AFTER RESTORATION

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Abstract
Old traditional orchards can be characterized by trees in standard (or half-standard) forms to ensure longevity and by the orchard floor consisting of specific grasslands formed by repeated traditional management, be it grazing by house animals or mowing for hay. The restoration of old neglected traditional orchards is a complex process and its goal is not only to improve the status of the fruit trees but also to achieve sufficient biodiversity of the orchard floor. During the 2017 growing season, we assessed two recently restored neglected orchards (2014 and 2015) to find out how much they resemble their desired status two and three years after the restoration. The desired status was deduced from two closest functional traditional orchards which were used as reference sites. Our results indicated that biodiversity in the orchard floor of both restored orchards was actually higher than in their reference sites. At the same time we discovered that after three years, biodiversity in the orchard floor was remarkably close to its reference site indicating that even though a forestry tiller had to be used during the turf establishment, after three years the restoration was already successful in returning desired biodiversity to the site.

Key words: extensive orchards, traditional orchards, forestry tiller

Introduction

Traditional orchards (TOs), similarly called extensive orchards have never been used for fruit production only. Therefore a rather extensive way of management has developed without chemical pesticides, fertilization or irrigation. They can be mostly characterized by trees in standard or half-standard form, longer distances between trees, no fencing, lesser costs of establishment, lesser production and income, significant longevity and invaluable nonproduction ecosystem functions (Boček, 2015).

The production function of TOs is not limited to fruit but also to fuel wood and more importantly forage and hay and to a lesser extent bee honey. However, they also possess ecological, social, historical, aesthetic and recreational value. In todays´ Czech landscape, these values greatly exceed their production potential (Kovář, Jandová, Pojer, 2012). TOs are one of the most valuable biotopes ever created by man. They combine two types of landscapes; grasslands and forests. Therefore they are recognized as woody steppes (Häseli et al., 2003). However, whether this is true or not in the Czech TOs is still unknown. In this paper, a botanical assessment of the species in the orchard floor was carried out to find out what their light demands are and whether the biotope resembles more steppe or forest.

The history of TOs in the Czech Republic is rather grim. Lots of them were destroyed in the 60s-90s as the communist regime sought after more arable land. After the political changes in 1989, the orchards were returned to their rightful private owners who, in most cases, did not have the tools or possibilities to manage them anymore after the 50 years of detachment. These abandoned neglected orchards have been recently the target of restoration activities supported by a

number of European and National grants. The reason for it is mostly their ecological values and the social demands for recreation in the landscape.
The restoration of neglected TOs is a challenging task (Deutscher, 2015). From the ecological point of view, the most problematic part of it is orchard floor preparation as it includes eradication of unwanted tree species and scrubs and tillage to achieve a flatter orchard floor. The fruit trees and the grassy turf need a special micro-climate with sufficient sun and air. According to the original status of the restored orchard this process can be dramatic as a significant number of unwanted trees and shrubs (usually neglected orchards are overgrown by pioneer forest tree and shrub species) may have to be cut down. At the same time, it is very important to remove all the belowground parts of woody plants as well to prevent them from coppicing to support the desired steppe grassland species. The easiest way is to use a forestry tiller that is capable of preparing the orchard floor up to 10-20 cm below ground which also incorporates the organic matter back to the soil. Apart from the obvious positives of such technology, this process is harmful to both the current herbs and insects on the locality (Krása, 2015). These negative impacts can be mitigated by the timing of the tilling as well as leaving refugee sites on the locality such as leaving some dead trees as torsos and some parts of the lawn intact. However, this is only possible if there are still some functioning valuable parts of the orchard that can be used this way. In this paper, two neglected orchards that were recently restored (2014 and 2015) using a forestry tiller to prepare the orchard floor were evaluated to find out how quickly does the combination of seed bank and lawn sowing help return the biodiversity of the orchard floor to a desired status.

Material and methods
During May 2017, we assessed the flora in the orchard floor of two recently restored neglected orchards (Kojatice 2014 and Babice 2015) to find out how much they resemble their desired status two and three years after the restoration. The desired status was deduced from two closest functional TOs which were used as reference sites. In all four orchards, four phytocenological images 4*4 m were evaluated; two in the shade below the canopy and two on a sunny site. The Shannon-Wiener (Spellerberg and Fedor, 2003) index was used as a description of species diversity while the Ellenberg (Ellenberg, 1992) index was used as a description of light demands.

Results and discussion
The highest species diversity was observed in the two restored orchards. Which is caused by the combination of lawn sowing that took place during the restoration process and the involvement of early succession species that are not present in the older orchards. When comparing variability in the phytocenological images as an indication of the variability within the orchards themselves, the highest variability was observed in the old Kojatice orchard and the least in the restored Babice orchard. The reason is that the difference in light conditions under mature trees and on sunny sites is more profound in the older orchards as the old trees have larger dense canopies.
Even though the same lawn seed mixture was used for both localities, there are some species that were not in it and still have found their way into the lawn. For example, *Anthoxanthum odoratum* is only present in Babice and not in Kojatice. This grass can be found in the old Babice orchard and probably was a part of the original seed bank. Another such species is *Alopecurus pratensis* that is only present in

Kojatice (both in restored and old). This indicates that the functioning of the seed bank two years after tilling can already be observed.

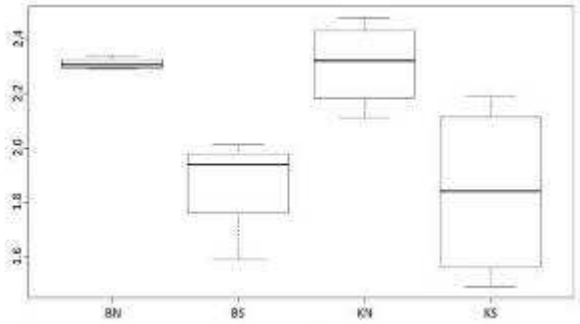

Fig. 1: Shannon-Wiener index of species diversity (BN and BS – Babice restored orchard and Babice reference site, KN and KS – Kojatice restored orchard and Kojatice reference site)

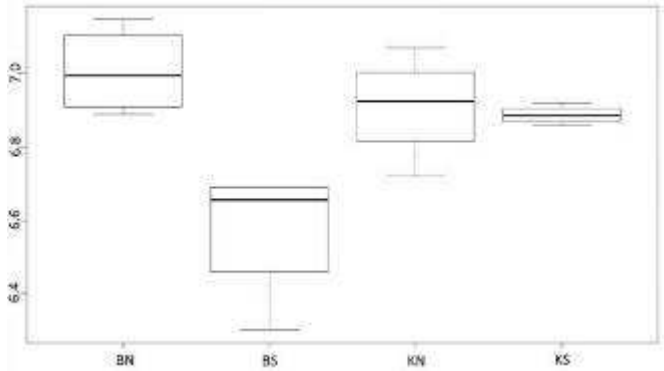

Fig. 2: The Ellenberg index of light demands (BN and BS – Babice restored orchard and Babice reference site, KN and KS – Kojatice restored orchard and Kojatice reference site)

The highest light demands were observed by the species present on newly restored sites and the old Kojatice orchard. In the restored ones, the reason is that early succession species are heavily heliophylous (Townsend, 2008). The big difference between the old orchards is caused by the distance between trees. In BS it is 8 m while it is 16 m in KS. Therefore more light demanding species have evolved in the orchard floor of KS. At the same time the surroundings of BS are overgrown by shrubs and pioneer tree species and the locality is shady as a whole.

For a comparison, the Ellenberg index in forest stands usually reaches 2.8-4.3 (Svobodová, 2014) while in sunny meadows 6.9-7.1 (Klíma, 2016). Our results in the old reference sites vary between 6.6 and 6.9 which indicates that the species of the orchard floor are much more heliophylous than originally thought and their species composition resembles meadows much more than forest stands. This has to be taken into account during the restoration process and during the design of the lawn seed sowing mixture.

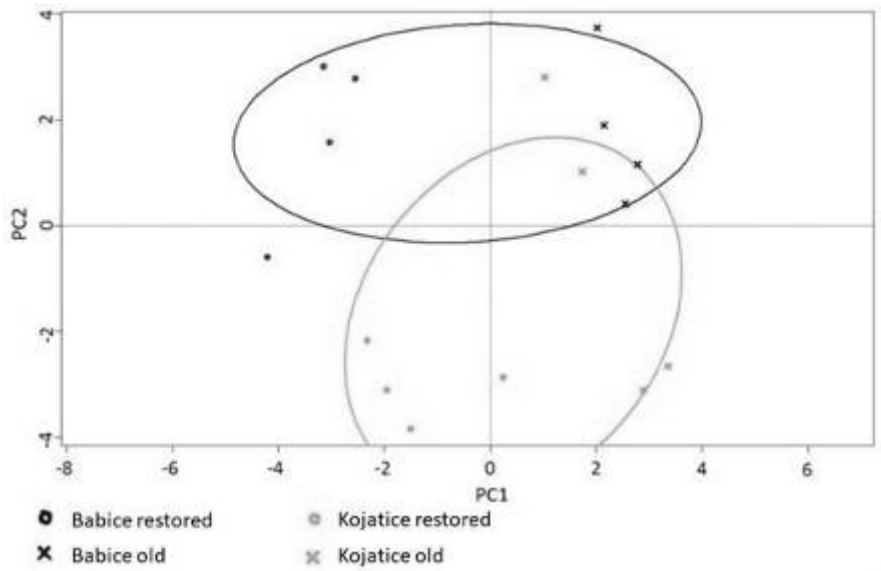

Fig. 3: Poly-criteria analysis PCA (BN and BS – Babice restored orchard and Babice reference site, KN and KS – Kojatice restored orchard and Kojatice reference site)

On the PC1 axis the difference between restored and old orchards is presented. The tighter the ellipse, the more similar the species in the orchard floors are. On the PC2 axis the differences between the two localities (Kojatice and Babice) are presented. The total difference between the restored and old orchards reaches 5.5 and 3.75 for Babice and Kojatice respectively. In other words, the restored orchard in Kojatice is more similar to the old reference site than Babice. This comes as no surprise as Kojatice was restored in 2014, while Babice in 2015 and this one year difference in natural development of the orchard floor is responsible for this. More importantly, three years after restoration, the species diversity in the orchard floor is already approaching its referenced ideal status.

Conclusion

Our results indicated that the species composition in the orchard floor in traditional orchards resembles much more meadows than forests in contrast to the traditional understanding that orchards are woody steppes. The heavily heliophylous species composition has to be taken into account when designing the lawn sowing seed mixture during future restorations.

Our results also indicated that the herbal species diversity in the orchard floor is approaching its desired status already three years after restoration even if a controversial “hard” method of forestry tilling is used for orchard floor preparation.

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Souhrn

Během vegetační sezóny v roce 2017 byl hodnocen bylinný podrost ve dvou extenzivních sadů obnovovaných v nedávné době (2014 a 2015). Cílem bylo zjistit nakolik se 2 respektive tři roky po obnově podobají cílovým společenstvům a současně vyhodnotit, zda jsou v nich obsaženy spíše lesní, či spíše luční světlomilné druhy. Cílový stav byl odvozen ze dvou nejbližších funkčních extenzivních sadů, které byly využity jako referenční lokality. Naše výsledky ukázaly, že v podrostu všech zkoumaných sadů se nachází zejména luční světlomilné druhy bylin, což je v kontrastu s obecně přijímanou hypotézou že extenzivní sady jsou lesostepní společenstva. Bylinný podrost je totiž složen téměř výhradně z lučních druhů. Dále naše výsledky naznačují, že již tři roky po obnově se druhové složení bylinného podrostu velmi podobá svému cílovému stavu a to přesto, že byla při obnově použita kontroverzní "drastická" metoda celoplošné přípravy půdy zarostlého zanedbaného sadu půdní frézou. Ukázalo se, že semenná banka v kombinaci s výsevem trasní směsi půdě extenzivních sadů má vysokou schopnost regenerace.

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THE PERCEPTION OF PROTECTED LANDSCAPE AREAS

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Abstract
The nature and landscape conservation is often the subject of discussion, especially in the context of regional development. In additions to conservationists and representatives of public authorities, there is a group of people that does not agree with declaring of conservation in territory which could be potentially declared as Protected Landscape Areas (PLAs) and its surroundings. This often leads to emotional debates full of counter-arguments. The declaration of the Soutok PLA could be a proof of the long-standing dispute over the nature conservation. The article deals with the analysis of documents, interviews and opinions that was found through the qualitative research (Hendl, 2012). The results point the fact that the residents living in the PLAs, which are already declared, perceive the territorial protection positively. The perceptions and attitudes to protected areas have been identified as a key factor for its successful management. The problem of the counter-arguments is that there was no tradition of participating and there was poor knowledge and poor communication between the conservationists and stakeholders.

Key words: Pálava PLA, Moravian Karst PLA, Development of the Region, Nature and Landscape Protection, Special Protection Areas

Introduction

This paper deals with a perception of PLAs in the Czech Republic by stakeholders in the already existing PLAs on the one hand, in territory of rivers Morava and Dyje's confluence (Soutok PLA) on the other. The history of efforts to declare Soutok PLA dates to the first half of the twentieth century. Within these years that were characteristic for making intense efforts to declare the Soutok PLA, several arguments from stakeholders had been raised. These are regarded as crucial of the resistance against the PLA declaration. One of the most important groups of stakeholders in PLAs are the residents and landowners.

Perceptions of protected areas establish the degree of successful area protection management (e.g. Stoll-Kleemann, 2001; Arnberger, Schoissengeier, 2012; Arnberger et al., 2012). The perception of local stakeholders is influenced by several entities that are interconnected as it is shown in a theoretical scheme (Fig. 1).

According to Trakolis (2001) it is necessary to consider the differences of opinions and perception of the benefits which flow from the PLAs.

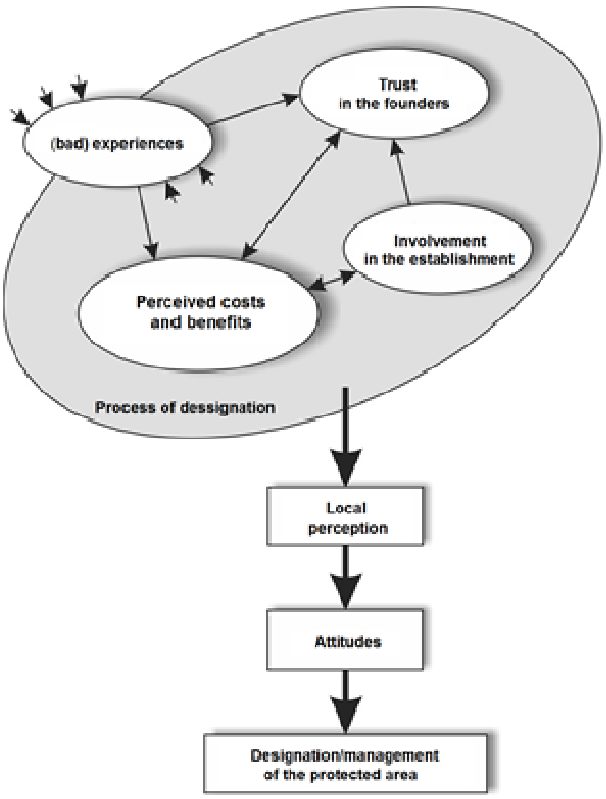

Fig. 1: Theoretical scheme of the relationship between factors influeancing the local perception of the protected areas (Source: Nastran, 2015)

Local stakeholders especially perceive the benefits that are received and observed within a short period of time. They find personal material benefits more convincing than immaterial benefits and utility for the public. Allendorf et al. (2007) also points out that some of past events are quickly forgotten (e.g. infrastructure projects, increased employment etc.). The situation, when the benefits of PLA are forgotten, contributes to a rather negative perception of the protected areas (Spiteri a Nepalz, 2005).

Materials and methods

Arguments that were raised within negotiations about the declaration of Soutok PLA are verified based on interviews and survey. Respondents for the interviews were chosen based on goal-directed choice. In each of chosen protected landscape areas there were chosen mayors of local municipalities at the periphery of PLAs that are not touched by tourist business and vice versa there were chosen municipalities located in immediate proximity of the most visited tourist destination of the concrete PLA. The overview of all respondents is shown in Table 1.

Arguments concerning restrictions on citizens and visitors were evaluated based on a questionnaire survey, which was attended by 200 respondents.

Tab. 2: List of Respondents (interview)

Respondents in Moravian Karst PLA	**Respondents in Pálava PLA**
Mayor of Blansko (Polák)	Mayor of Dolní Věstonice (Rajchlová)
Mayor of Kanice (Kalivoda)	Mayor of Pavlov (Duhajský)
Mayor of Ostrov u Macochy (Hudec)	Mayor of Přítluky (Kadlec)
Mayor of Vilémovice (Kala)	Mayor of Sedlec u Mikulova (Pelán)
Deputy Managing Director of Training Forest (Enterprise Masaryk Forest Křtiny (Mauer)	Nature Protection Officer of the Operations Department of Forest Plant Židlochovice (Dovrtěl)
Director of the Administration of Moravian Karst PLA (Štefka)	Director of the Administration of Pálava PLA (Kmet)
Deputy director of Regional Development Agency South Moravia (Opluštil)	

Results

The most common reason, why the residents of the Soutok region do not want to declare PLA, is the fear of limiting daily movement and the loss of the attractiveness of this territory. It is probably based on the experience of the past years, when the territory was a part of frontier zone with a forbidden entrance (it lasted for 40 years).

As emerged from results of interviews and questionnaire survey, there is no restriction on daily movement and entry to the forest that would results from the PLA statute. The decrease of area's attractiveness does not correspond with PLA statute. It is confirmed by another works (e.g. Schneider and Lorencová, 2015). For 63.5 % asked persons these areas outside of large protected areas pieces of land are of the same attractiveness as PLAs and national parks themselves. For 35 % of respondents the large protected areas are considered more attractive.

The tourism has its negative impact especially in case of high concentration. The phenomena can be severely damaged by tourists. For this reason, it is possible to introduce some restrictions. This problem was solved in the Moravian Karst PLA. According to Štefka, there are several caves, where is degraded up to 75 % of the original decoration where. Therefore, measures are taken (limiting the number of people in the sightseeing groups, reducing the total number of visitors per day, etc.). However, it should be noted that such restrictions should take place in all high traffic locations that generate devastation of protected phenomena. But this affect visitor's thinking about the protected areas negatively.

The presented work shows that chosen arguments are irrelevant. The municipalities in the already declared PLAs especially in the field of tourism, or in services mostly benefit. Most of the respondents mentioned they are proud to live in Protected Landscape Area. They also stated that the PLAs statute generates more benefits than disservices. On the other hands, the opponents of the PLA cannot imagine that someone around them takes care of the territory better than they themselves.

The most important factors for nature and landscape protection are communication and cooperation between stakeholders and conservationists. Above all, the bad reputation of the nature protection leads to negative perception of the issue. It is necessary to consider municipalities and stakeholders in nature conservation as partners.

Discussion

The declaration of the PLA is considered the strongly restrictive instrument by the contemporary society (Seják et al., 2010). The general opinion of the society implies that any alternative use of a locality is forbidden (e.g. Kalousek et al., 2009).

As for comparing of alternative land's use it is not possible to say strictly what from possibilities is more economic advantageous for a region, because the nature's value is not measurable. For an expression of its value there is e.g. a concept of ecosystem services that understands the ecosystem functions like a type of services (Pithart a kol., 2010) providing set of advantages for human welfare (Seják et al., 2010). Many of these can be expressed by economic value that is derived from costs for false ensuring of such services (de Groot et al., 2010). In spite of the fact, that these services are increasingly considered as environmental policy makers (Boithias et al., 2016), these are not considered during the decision-making on land use (Sejak et al., 2010).
However for some participants of regional development the PLAs can represent 'non-places' on the economics maps (Jiřičková, 2014). According to the interviews with mayors the PLAs do not slow down the municipalities' development.
The presented work shows that the inhabitants of the Protected Landscape Area consider the status of nature protection as a "regional brand", which increases the demand especially in terms of their services. It is well known that a positive approach to a protected area affects the successful management of PLAs. The results show visibly that communication is some kind of base of successful cooperation since the mutual coordination of steps is for problem-free functioning and coexistence of nature conservation and regions' development necessary.

Conclusion

Most respondents had a positive attitude towards protected areas. The perception is influenced by experiences with establishers and some stereotypes. The analysis of stakeholder's attitudes and perceptions revealed potential conflicts that could affect the management of protected areas. The main problems are limited knowledge and poor communication with the authorities, which results in a lack of local participation in conservation activities and deformed perception of protected areas. This corresponds with the arguments, which was raised against the declaration of the Soutok PLA. While PLA residents perceive a nature conservation status very positively, residents of potential PLA reject it. Their doubts arise from public opinion that is predominantly formed by the stakeholders and stereotypes. These opinions are mostly not supported by facts and we could describe it like an anachronism.
Nowadays protected areas are the main tool for conserving biodiversity. In many cases, however, the conservation aims creates conflicts with local community. It is a real challenge for administrative institutions involved in the management of protected areas to change their goals of better communication and cooperation with the residents and stakeholders of the proposed protected areas. Public and entrepreneurial participation must be encouraged to achieve sustainable management of protected areas, because only in this way can all parties prosper.

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Souhrn
Ochrana přírody a krajiny je často diskutovaným tématem. Pro některé účastníky regionálního rozvoje představují chráněné lokality „bílá místa" na ekonomické mapě regionů. Obyvatelé lokalit, které mají potenciál být vyhlášeny za CHKO, se většinou proti tomuto rozhodnutí brání. Důkazem toho mohou být i dlouholeté diskuze o vyhlášení CHKO Soutok. Tato z důvodu neustávající nevole tamních stakeholderů nakonec vyhlášena nebyla. Cílem práce bylo zanalyzovat vybrané argumenty, které byly vzneseny proti vyhlášení CHKO Soutok, v již existujících CHKO Moravský kras a Pálava a zjistit, zda jsou obavy opodstatněné. Z výzkumu vyplynulo, že obyvatelé obcí, které spadají do CHKO, nepociťují žádná omezení při běžných denních činnostech. Atraktivnost regionu dle jejich názoru vyhlášením chráněného území neutrpěla, spíše naopak. Pro správné fungování managementu ochrany přírody je nezbytná komunikace mezi ochránci přírody a místními obyvateli, o kterou se v uvedených případech správy CHKO snaží. Z výše uvedeného vyplývá, že vybrané argumenty lze v souvislosti s vyhlášením chráněného území považovat za neopodstatněné.

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POSSIBLE INFLUENCE OF SINGLETRAIL MORAVIAN KARST CONSTRUCTION AND USE ON DAMAGE TO SURROUNDING TREES

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Abstract

This paper presents a part of a project created based on the requirement of the Training Forest Enterprise Masaryk Forest Křtiny to monitor the effects of singletrail construction and use on the operations of Training Forest Enterprise Masaryk Forest Křtiny forest management. The singletrails within the territory are run by SINGLETRAIL Moravian Karst association. The project began in September 2017, planned for three years, and one of its parts assesses the impact of the construction and operation of the trails on the damage to the surrounding trees. The trees along the biking trails will be evaluated in two periods. In spring, the crown condition will be assessed using the ICP Forests methodology, supplemented by the characteristics of habitual diagnostics: the inventory of damage to stems and buttress roots, finding new damage including the size of the wound, its depth and location, checking old damage, finding potential symptoms of pest attacks. In autumn, only the inventory of stem and buttress root damage will take place, finding new damage including the size of the wound, its depth and location, checking the old damage and looking for the presence of fungal diseases. The symptoms of biotic infestation will be described according to the ICP Forests methodology. The paper presents the methodology and partial results of the project's first autumn measurements.

Key words: singletrail, damage, tree, forest stand

Introduction

Mountain biking is a popular recreational activity worldwide and technological advances have made riding easier and more comfortable (Koemle and Morawetz, 2016). Furthermore, biking has quickly differentiated into different riding styles such as down-hill biking, tour and cross-country riding, competition style riding types such as free-riding or four-cross, among others (Quinn and Chernoff, 2010). Koemle and Morawetz (2016) investigated how to adjust trails to better match the interests of bikers while still respecting regulations which are in the interests of landowners, hunters and ecological concerns. They found that at least in Austria official trails do not necessarily match the preferences of bikers and therefore they often ride on unofficial trails or on trails where biking is not allowed and this behavior can result in conflicts with other trail users and conservationists. Along with the rapid rise of mountain biking there has also been an increase in associated problems. Of particular concern are riders going off designated trails. Concerns of resource managers include the safety of all trail users, user conflicts, crowding, and environmental degradation (White et al., 2006). Zajc and Berzelak (2016) found out that in Slovenia, access to forest single tracks and signposted mountain trails, which are highly preferred by mountain bikers, is generally not legal. There is also a lack of mountain biking management and infrastructure at the national level. They see an

important challenge for mountain biking management in natural areas related to conflicts with other user groups. Pickering et al. (2011) states that mountain biking is an increasingly popular, but sometimes controversial, activity in protected areas. They compared the impacts of mountain bike riding off trail to those of hiking on subalpine grassland in Australia using a modification of a common trampling experimental methodology. The research proved reductions in vegetation height, cover and species richness, as well as changes in species composition and increases in litter and soil compaction with riding.
The aim of the first autumn assessment was to determine the number of trees damaged in relation to the use of singletrails in the territory of the Training Forest Enterprise Masaryk Forest Křtiny (Fig. 1). The assessment took place in autumn 2017 and all the trees along singletrails 2 and 4 and parts of singletrails 1b and 5 were evaluated. The evaluation looked for the trees that could be damaged by the construction of the trails or riding on them. The damage in focus was that done to the roots, buttress roots, and stem bases.

Fig. 1: Situation of the area

Methodology

1. Tree social class and species

According to Eichhorn et al. (2010), Kraft classes express the relation of a tree height to the height of the surrounding trees. Information on the tree's social class is

useful for the interpretation of the data (shows the growth potential of the tree, the light conditions of the crown, etc.).

- dominant – trees with the crown top above the main stand level, also includes free-standing trees
- co-dominant – trees with crowns in the main stand level
- subdominant (partially co-dominant) – trees extending to the main level and so receiving part of the light from the above, still lower than dominant or co-dominant trees
- dominated (shaded) – trees with crowns below the main stand level not accepting any direct light from the above
- dying (suppressed)

2. The stem distance from the singletrail

- in direct contact with or in the singletrail road formation (roots visibly reaching to the singletrail formation)
- up to 1 meter far
- up to 2 meters far

3. Tree damage and disease

The presence of wounds and abrasions up to a height of 2 m evaluated.

3.1. Damage type

- cut after branch trimming
- bark abrasion
- surface wound reaching the sapwood
- crack
- resin bleeding (conifers)
- sap bleeding (broadleaf)
- expanded stem basis (spruce)
- other damage (cancer, etc.)

3.2. Size of abrasion or wound

Evaluated for damage types 1–3.

- up to 3 cm2
- 3 – 40 cm2
- 40–200 cm2

3.3. Presence of symptoms of decay and pest infestations

The presence of sporocarps, rhizomorphs, syrocia, feeding marks and other obvious evidence of fungi or pest attack evaluated. Verbal description, determination of the originator (if possible), or photos for determination.

3.4. Location of occurrence

Evaluated for damage type and the identified symptoms of decay and pest attacks.

3.4.1. roots
3.4.1a. towards the singletrail
3.4.1b. towards another side
3.5.2. buttress roots
3.5.2a. towards the singletrail
3.5.2b. towards another side

3.6.3. stem basis
3.6.3a. towards the singletrail
3.6.b. towards another side

Results

Half of the trees evaluated and inventoried along the singletrails were damaged. The most common damage is bark abrasion, which is dominant for singletrails 1b and 5, and second as regards the number of wounds for singletrails 2 and 4. Additionally, cracks are found in large numbers along all of the singletrails. Wound reaching the sapwood is significant only for singletrail 2. Cut after branch trimming is dominant for singletrail 4 – this is not directly related to the trail use by cyclists, but rather to its maintenance. Frequently found damage is resin bleeding, which usually occurs in connection with other damage. The frequency of damage is clearly associated with the orientation of the damage related to singletrails. Damage to roots, buttress roots and stem bases are significantly represented in all evaluated singletrails, always on the side towards the singletrail. The size of wounds is variable in all singletrails. The results show that the most damaged trees are those located within 1 m far from the singletrails.

Conclusion

The autumn assessment confirmed the assumption that the operation of the singletrail has a negative impact on the surrounding trees in terms of their damage caused by both bikers and maintenance of the trails. Currently, the situation can be assessed as a tolerable one. However, ideally, it would be advisable to design the trails so that their sufficient width parameters will eliminate any possible damage to the adjacent trees. Mentioned approach requires larger appropriation of forest land, a reduction in the area of the stands and the loss of forest ecosystem production. The compensations for landowners due to the complications should be defined already at the project preparation stage.

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Souhrn
Článek prezentuje dílčí část projektu, který vznikl na základě požadavku ŠLP Křtiny monitorovat vliv výstavby a provozu singletrailů společnosti SINGLETRAIL Moravský kras na provoz lesního hospodářství ŠLP Křtiny a představuje metodiku a dílčí výsledky projektu prvního podzimního měření. Cílem prvního podzimního hodnocení bylo zjistit počty poškozených jedinců v souvislosti s užíváním singletrailů na ŠLP ML Křtiny. Hodnocení se uskutečnilo na podzim roku 2017 a hodnoceny byly všechny stromy podél singletrailů 2 a 4, a na části singletrailů 1b a 5. Předmětem hodnocení byly stromy, které mohou být poškozeny výstavbou tras nebo pojezdem po nich na kořenech, kořenových náběžích a bázi kmene. U všech hodnocených singletrailů nebo jejich částí byla přibližně polovina ze zaznamenaných jedinců poškozena. Nejčastějším poškozením je oděrka kůry, která je dominantní u singletrailu 1b a 5, a u singletrailu 2 a 4 je co do počtu poškození na druhém místě. Dále se ve větším počtu u všech singletrailů vyskytuje poškození prasklina. Pouze u singletrailu 2 je výrazně zastoupeno poškození rána zasahující do běle. U singletrailu 4 je dominantní poškození řezná rána po ořezu větví, která nemá přímou vazbu na užívání singletrailu cyklisty, ale je spojena s jeho údržbou. Častým poškozením je i smolotok, který se obvykle vyskytuje souběžně s jiným poškozením. Četnost poškození má jednoznačnou spojitost s orientací poškození vzhledem k singletrailu. Poškození na kořenech, kořenových náběžích i na bázi kmene, jsou výrazně zastoupeny u všech hodnocených singletrailů, vždy na straně k singletrailu. Velikost poranění je u všech singletrailů proměnlivá. Z výsledků lze vyvodit pouze to, že nejvíce poškozených jedinců se nachází do 1 m od singletrailu.

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THE PUBLIC AND FOREST ROADS FROM THE PERSPECTIVE OF RECREATIONAL USE

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Abstract
The right of everyone to enter the forest and move freely within it can be described as the general use of the forest. It is, among others, enshrined in § 19 of Act No. 289/1995 Coll., on forests, which provides the right of everyone to do so at their own risk, but also the obligation not to damage the forest, not to disturb the forest environment and to follow the instructions of the owner or the tenant and his employees. The right of owners is considerably limited by the general use institution. On the other hand, the following provision (§ 20) exhaustively defines activities which are prohibited in the forest, or which can be operated only on forest roads. The forest road is publicly accessible. From this statute arise certain obligations for the owners, but equally important is to realize, not just for the owners but especially for the public, which roads of the forest communication network can be referred to as forest roads.

Key words: forest accessing, public use, Act no. 289/1995 Coll. on forests

Introduction

The public use of the forest is enshrined in the Czech legal system. This concept means the right of everyone to enter the forest and move freely within it. It is enshrined, among others, in § 19 of Act No. 289/1995 Coll., on forests, which provides the right of everyone to do so at their own risk. Damages have to be paid only if the obligations of the owner has been breachead, not from the so-called "force majeure" - the events that are unaffordable by this person. In particular, the above-mentioned provision specifies the activities that can be carried out in the forest, but also the obligation not to damage the forest, to disturb the forest environment and to observe the instructions of the owner or the tenant. The right of the owners is limited by the public use institution.
Many activities are forbidden in the forest or are only directed to forest roads. Their exhaustive summary is provided by § 20 of the same law. If these activities take place outside of them, it is illegal activity and the person who performs it is responsible for the eventual damage. He also bears full responsibility in the case of activities which are prohibited in the forest.
Due to the increasing use of suburban forests for various leisure activities, it is necessary to deal with the management of the occupancy in all its aspects.

Materials and methods

Forest is not just an ecosystem or source of materials. Nowadays, it also serves as a recreational area for a large part of the population. These people come for many activities, which can potentially cause conflicts not only among the visitors themselves but also between them and the owners activities. The aim of this text is to analyze the rights and obligations of interest groups and to outline possible solutions to the most common problems arising from the current use of the forest ecosystem.

The basic information source for this text is the czech legislation. The most important norms are: Act No. 289/1995 Coll., on forests, Act No. 13/1997 Coll., on roads, Act No. 89/2010 Coll. Civil code, as amended and Czech State Standard ČSN 73 6108 Forest Transport Network. The Ombudsman's opinions are also important. The text focuses mainly on the issue of general use of the forest road network. However, it is necessary to define public use of the forest in general. The term "forest path" will be worked out as defined in the article "Definition of the forest road according to Act No. 13/1997 Coll., on roads and its public access in the Czech Republic ". On this basis, it is possible to determine the activities that are acceptable for these roads and under which conditions. Equally important is the determination of whoever bears the responsibility if the damage occurs when performing these activities.

Results

Although the public use of the forest is at its own risk, the private law has to be applied here, namely the Civil Code (Act No. 89/2010 Coll.), whose provisions §2900 regulates a general preventive obligation imposing on everyone to behave so that there is no detriment to life and health, but also to property. In connection with this it is always necessary to individually examine what can be expected, what danger can be foreseen, and to what extent the danger could be avoided (§2910 stipulating that everyone is responsible for the damage caused by the breach of their legal obligation). If such damage arises, its compensation will be governed by §2958, taking into account the degree of fault on both sides. There is alo a notification obligation in the Civil Code. If the owner will warn those, who are at risk, without unnecessary delay when the obligation is breached or in conscious that it will be breached (or if the responsible person should know about a possibility), he is not liable for any damage. He also does not bear the responsibility in the case of damage caused by natural forces or by the fault of the other person (§63/5, on nature and landscape protection).

The Act on roads splits purpose roads, including the forest road, to publicly accessible and publicly inaccessible. Each category must fulfill its basic characteristics. In the case of publicly accessible communication, it is a constant visibility in terrain. However, it is not applied, if the road can not be used due to the illegal behavior of the owner, which is represented, in particular, by the placing of fixed barrier and the road becomes unrecognizable. Its purpose is access to certain foreign property, the conection of it with each other or other roads. Furthermore, there must be at least the implicit consent of the owner and the existence of the necessary communication need. The road becomes public by a dedication to general use (an institution that allows a relatively unlimited group of people to use it) or if it is "from time immemorial". The term refers to such a general use of communication, for which it is difficult to prove the manifestation of the owner's will of public accessibility. Consent results from the fact of the existence of the road and its use to date. Further criteria arose from the decision practice of the courts. One of them is the consent of the owner with using of the road by the public. It does not matter whether the owner gave it expressly or implicitly, other than oral or written way, but without any doubt about his will. An important fact is, that it is binding for his legal successors. This avoids the purpose transfers with intent of the exemption from the obligation. Another specific feature is the communication need that is fulfilled when there is no other adequate way to secure a communication link to property than just a limitation of ownership. If it exists, it should be preferred. An

alternative communications connection may exist even when the property is not directly connected to the road via the road (across a public space).
The characteristic feature of publicly inaccessible purpose roads is its location in an enclosed space or an object (a fenced and gated sports grounds, industrial complex,..) where the communication is used for the needs of its owner. It is only accessible to the extent and manner in which those persons have established. With respect to the institute of public use of the forest and the opinion of the Ombudsman, No.: 5076/2007 / VOP / DS, the forest can not be considered a closed area and can not be declared publicly inaccessible in the context of the foregoing forestry characteristics.

Discussion
A general preventive obligation is imposed on the owner to prevent damage and he bears the responsibility in case of breaching it. The aim of this institute is to ensure the safety of visitors. Fulfillment of it will, in the case of forest owners, consist in maintaining a good condition of forest and road network. The state of roads and of the vegetation must be under the control, the working and technological procedures must be observe and the neglect of health and safety requirements at work prevent. If the damage is already threaten, then in measures to avert it. If the owner warns of the threating danger, the injured party loses the right of compensation for the damage he could have prevented. In order to determine the extent of the obligations of these persons, it is also appropriate to define the regime of places with increased frequency of attendance, in which the activity is adapted to the capacity of the site, eg increased care of the forest in the surrounding of the road network and more frequent inspections, in order to preserve the state guaranteeing the safety of visitors. If the forest is a part of the non-intrusive areas with restrictions under §38 of Act No. 114/1992 Coll., on the protection of nature and landscape and threatens with danger, it is necessary to fulfill the notification obligation.
An important advantage in fulfilling the obligations is to direct and disperse visitors groups in the forest so that each visitor can operate without negative impact on the ecosystem, forest management itself and other visitors. However, this partially managed recreation brings increased demands on owners who have to deal with it more and more. An important point in this may be the creation of thematic facilities (playgrounds, nature trails, ...), where a group of visitors will find the background for their activities and will be mainly in its surroundings. Equally advantageous can be to direct visitors to locations where there is no conflict with economic activity. The disadvantage of such facilities is the responsibility of the owner for their condition. It is advantageous to draw up plans and maps of maintenance of forest roads, especially those on which routes are marked (cycling trails) as well as specialized facilities.
When using forest roads, there are several related acts. The most important is the Act No. 13/1997 Coll., on roads, which defines the paved and unpaved forest road as a purpose road under the regime of free general use in the usual way and for the usual purposes for which they are intended, as provided for in §19/1, unless the law provides otherwise. At the same time, each user has to adapt to the constructional and technical condition of the road.
The general use of forest roads is further modified by Act No. 289/1995, on forests. This act, in §3/1, classifies paved and unpaved forest road up to 4 m in the category of land intended for forest functions, which includes the term forest (§ 2 (c)). So it is possible to say that if the act talks about the forest, it also speaks about the forest roads, which are the routes of transport. The general use of these roads may be

modified or limited if it is necessary to protect the legitimate interests of the owner. However, it can not be done unilaterally, because of its public accessibility. At the request of the owner, the competent road administration office of the municipal office of the municipality with extended competence after the discussion with the Police of the Czech Republic is entitled to do so. The reasons and conditions of this are set out in §19/3 of the forest act. Public access can never be completely ruled out. A comprehensive review of activities prohibited in the forest is provided in § 20. On forest roads, it is forbidden to drive and park a motor vehicle. This prohibition has an exception for the persons who manage the works in the forest, as well as for those who has an exception from the owner (§ 20/4). The location of the road sign on the entry of the forest path can be made by after a local investigation, usually attended by the police. Subsequently, it is decided by so-called "determination" according to the §77/ c) of Act No. 361/2000 Coll., on roads. The procedure and the location of the sign is free of charge. The breach of the prohibition is punished as an offense under §53/1 g) of forest act.

On the contrary, the act No. 361/2000 Coll. in relation to motor vehicles in the §19 permits, within the limits of the law and special regulations, to use in principle all publicly accessible purpose communications unless their use is not specifically restricted. It is the general use that differentiates the forest roads from other publicly accessible purpose roads. Forest roads, according to the forest act – without the exception of the owner - can be used for walking, cycling, horseback riding, skiing or sleighing. Thus, the purpose of forest act regulation is not to regulate the conditions of use of forest roads, but only to limit their use in the act on roads in accordance with the objectives of the forest act - that is to say, in relation to the protection of the forest as national wealth.

Very important is the issue of use of access roads to built-up plots by motor vehicles, which is regulated in § 3 par. b) of forest act. This provision can be understood as an exception among other plots belonging to plots intended for forest functions. This also means the exclusion from the prohibition on motor vehicle use in relation to the protection of the interests of its owners. If such a exclusion would not exist, the right of private ownership would be seriously affected.

Conclusion

The forest is nowadays a place for recreation. People come with a variety of activities that are generally covered by the concept of public use of the forest. Although the public use is at own risk, the general preventive obligation does not cease here, according to §2900 of Act No. 89/2010 Coll., the Civil Code. The aim of this institute is to ensure the safety of visitors. If the damage arises, its compensation will be governed by §2958 of the same act, taking into account the degree of fault on both sides. The Civil Code also establishes a notification obligation. If the owner fulfill it, he is not liable for any damage. The same situation is in the case of damage caused by natural forces or by the fault of the other person (§63/5, on nature and landscape protection).

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Souhrn
Právo každého vstupovat do lesa a volně se v něm pohybovat, lze označit za tzv. veřejné užívání lesa. Je mj. zakotveno v §19 zákona č. 289/1995 Sb., o lesích, který stanoví právo každého tak činit na vlastní nebezpečí, ale zároveň povinnost les nepoškozovat, nenarušovat lesní prostředí a dbát pokynů vlastníka lesa či nájemce a jeho zaměstnanců. Institutem veřejného užívání je do značné míry omezeno právo vlastníků, kteří tuto skutečnost musí strpět. Na druhou stranu jsou v následujícím ustanovení (§20) taxativně vymezeny činnosti, které jsou v lese zakázány, případně, které je možné provozovat pouze na lesních cestách.
Lesní cesta je účelovou komunikací primárně určenou k obhospodařování lesa. Podstatné je, že se jedná o komunikaci veřejně přístupnou. Nelze ji tedy například z vůle vlastníka opatřovat závorou. Obecné užívání těchto cest pak může být omezeno pouze s povolením příslušného správního úřadu. Pro jízdu a stání motorovými vozidly pro tyto cesty platí všeobecný zákaz dle §20 odst. 1 písm. g) lesního zákona. Výjimku tvoří pouze příjezdové cesty k zastavěným pozemkům. Tato problematika je upravena v § 3 odst. 1 písm. b) lesního zákona a reflektuje požadavky práva soukromého vlastnictví.

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THE RELEVANCE OF DATA ON VISITORS IN GEOTOURISM DEVELOPMENT

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Abstract
Geotourism, similarly to other nature-based tourism forms, e.g., ecotourism, becomes more and more popular all around the world. Despite a large number of publications on various geotourism aspects, very low attention is paid to active geotourism participants – geosite visitors. However, data reflecting visitors' profile, expectations, preferences and/or motivation represent a key factor in the process of geotourism development towards the majority of potential visitors – the general public. Therefore, collecting data on visitors may significantly affect (un)success of geotourism destination establishment, especially in regions with relatively spread or solely located geosites. Using features of the Destination Business Intelligence System, geosite visitors data were analyzed to suggest the most optimal action towards future geotourism development respecting information obtained from potential visitors.

Key words: visitor-related data, geotourism, geosite, DBIS

Introduction

Geotourism has become a global phenomenon (Dowling 2011) all around the world. This concept is mostly practiced in the areas of geoparks. Recently, a total number of 127 (GGN 2018) geoparks are on the member list of the Global Geopark Network supported by the UNESCO. However, not only geoparks may offer geotourism experience. There are various locations of geotourism potential that may attract visitors to undertake geotourism, or any other nature-based (in this context primarily geoheritage-based), experience.
This article highlights the relevance of data obtained from potential visitors (Štrba et al. 2016a, 2017, Štrba 2018) implemented within the Destination Business Intelligence System (DBIS) (Štrba et al. 2016b, Kršák et al. 2016, Sidor et al. 2017) for the purpose of effective development of geotourism; as such data may significantly affect overall success within any tourism form or product respecting recently growing demand for the sustainability (e.g., Sharpley 2000, Buckley 2012, Jorgenson & Nickerson 2016).

Materials and methods

Focusing the aim of the study, an example area of the Zemplín region (eastern Slovakia) (Fig. 1), as an area of significant geotourism potential (Kršák et al. 2017), has been selected. The data obtained from potential visitors via online questionnaires were imported into the DBIS. Combination of data from previous research results related to the development of the DBIS (Kršák et al. 2017) and visitors' data conclusion was made in order to discuss the most optimal action towards future geotourism development.

Results and discussion

Considering the overall geotourism attractiveness and potential of the Zemplín region, the area includes four archaeological sites, 22 geo sites, geo-montanistic

sites, five historical sites, 22 cultural-historical sites, 17 recreational sites, seven wine tourism sites (Kršák et al. 2017). These numbers give a great opportunity to define and establish an attractive geotourism area. However, as in any tourist product, tourist motivation to visit the place and satisfaction has to be taken into account to build a visitors' loyalty and become a sustainable geotourism destination. According to the principles of geotourism (National Geographic 2017, Newsome 2011), geotourism is a sustainable form of tourism. As summarized by Ryglová et al. (2018), interest in sustainability within tourism can also reflect the growing number of tourists whose reason for traveling is to discover the authenticity of the places they visit (Munt 1994, Uriely 1997, Mowforth & Munt 2003, Kim & Jamal 2007) by interacting closely with local communities with whom they can share a common sense of reciprocity and engagement (Krippendorf 1987) aimed at preserving the natural, socio-cultural, economic, and environmental heritage of the destinations they visit (Meric & Hunt 1998, Kerstetter et al. 2004, Budeanu 2007, Del Chiappa 2009, Hose 2012, Štrba 2018).

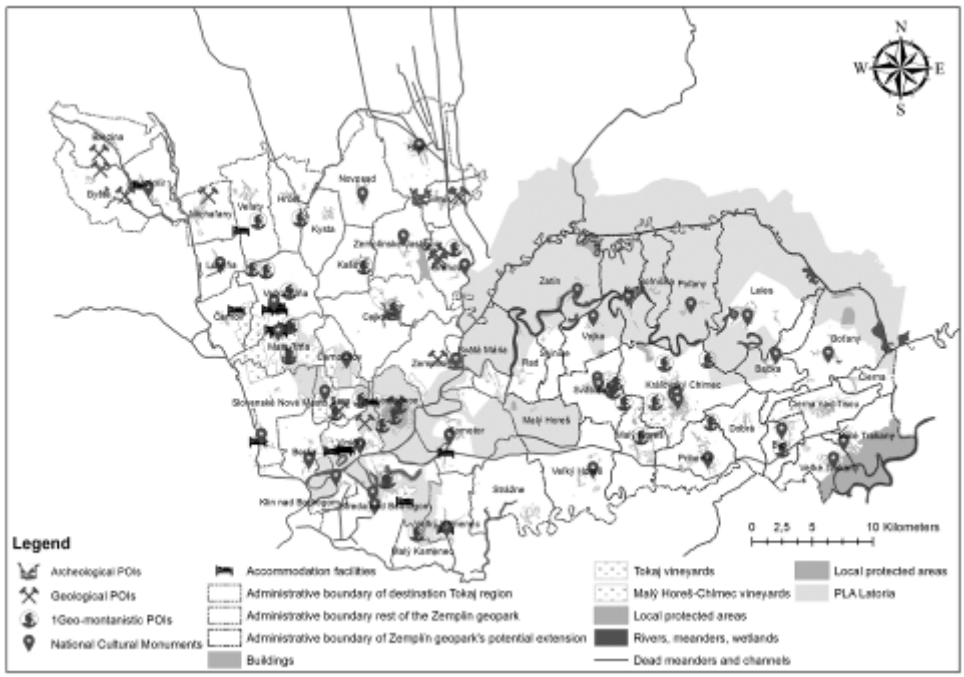

Fig. 1: Map of the Zemplín case study region (according to Kršák et al. 2017)

As presented in Table 1, a compilation of previously published research results (see, e.g., Csorvási 2016 or Štrba et al. 2017) in the field of potential geotourism experience participants gives very useful information on various aspects of geotourists.

Implementing of the data obtained from potential visitors to the example area of Zemplín gives following results:

1. The most significant locations (geosites) are located in areas with weak to very weak (occasionally no) infrastructure. So, potential visitors have a limited or no access to such sites. Therefore, the overall geotourism development potential level may decrease.

Tab. 1: Overview of various aspects affecting geotourism experience

criteria affecting geosite visit	motivation to visit geosite	factors perceived during geosite visit
visual attractiveness of locality	to explore new places	I have a pleasure of where I am and what I am doing
access		
tour/visit safety	to rest and relax	Spending time with family and/or friends
uniqueness/rarity		
information availability	to escape from daily routine	Possibility to learn something new
tour/visit difficulty		
time-limited visit	physical and mental regeneration	Visit of the geosite is based on my interest in such types of locations
tour/visit length		
possibility to gain knowledge	to gain knowledge	
a number of tourists		

2. Considering geosites “sensu stricto”, there is a lacking number of available and “general-public friendly” relevant information about the geosites. In this case, with no information on the site, visitors would potentially prefer a site with more information available. Moreover, taking into account the fact that the education/knowledge demand is included within all three studied categories (Tab. 1), there is almost no possibility to gain knowledge at most of the locations recently.
3. Non-existence or low-quality level of tourist/hiking trails connecting various geotourism attractive locations.

Conclusion

Effective geotourism product planning and development requires data inputs from various (often diverse) sources. One of the most essential inputs is represented by the data about potential visitors – geotourists. However, recent geotourism development is primarily focused on various aspects of geoheritage (e.g., location, value, representativeness, etc.) and very low attention is paid on geotourism participants – people for whom the various geotourism products are introduced. Ignoring expectations of visitors may result, in both short and long-term period, into the loss of original attractiveness of the area and wasting its potential. On the other hand, a combination of various input data sets including relevant data on visitors, as presented in this paper using DBIS platform, results in much more effective future recommendations towards geotourism development.

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Souhrn
Článek zdůrazňuje důležitost údajů získaných od potenciálních návštěvníků implementovaných v rámci cílového Business Intelligence System (DBIS) za účelem efektivního rozvoje geoturismu; neboť tyto údaje mohou významně ovlivnit celkový úspěch v jakékoli podobě cestovního ruchu nebo produktu, který respektuje nedávno rostoucí poptávku po udržitelnosti. Implementace dat získaných od potenciálních návštěvníků do DBIS na příkladu oblasti Zemplín poskytuje následující výsledky: (1) Nejvýznamnější lokality (geosity) se nacházejí v oblastech se slabou nebo žádnou infrastrukturou; (2) chybějící počet dostupných a relevantních informací o geositech a 3) neexistence nebo nízká úroveň turistických / turistických tras spojujících různé atraktivní lokality v oblasti geoturismu. Respektování poznatků získaných kombinací různých datových vstupů pomocí DBIS může vést k mnohem efektivnějšímu rozvoji nejen geoturismu.

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THE STATISTICAL ANALYSIS OF THE RESILIENCE MODULUS OF LOW VOLUME ROADS PAVEMENT DESIGN IN THE CONTEXT OF NATURAL RESOURCES PROTECTION

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Abstract
Defining a suitable resilience modulus for a material is crucial to optimize the layer's thickness in the design of pavements of Low Volume Roads with the aim to minimise the enviromental impact. Therefore, non-renewable resources will not be unnecessarily used up. As the examined samples consist of a natural materials, its modulus varies according to natural conditions and to obtain credible results it is required to introduce the influence of the uncertainties. For that reason, a statistical model will be used to represent the resilience modulus, based on the changes in humidity and density. The input data of the statistical model are obtained from the California Bearig Ratio cyclic tests carried out in the Mendel University's laboratory.

Key words: low volume roads, environmental impact, cyclic california bearig ratio, module of resilience, soil, statistical nalysis, natural resources protection

Introduction

Low Volume Roads (LVR) are essential for the social and economic development of low-population human communities. These communities are often located in mountainous or semidesert places where the access of the basic services is complicated. LVRs play an important role in the European economy, because of forestry activities, such as wood extraction, and they are also used for leisure vehicles, pedestrians, or cyclists.

The name low volume arises from the intensity of the transport, as the density of the vehicles is lower than in conventional roads (the maximum of heavy vehicles is 400 per a day). Other common characteristic related to this type of roads is that are constructed using natural materials.

In the design of LVRs some parameters such as location, drainage, stability, construction, maintenance costs and the security must take into account, as well as, having an accurate material. The usage of local soil is important in the construction of LVRs, in order to decrease the environmental impact, as less modifications in the properties of the landscape will occur. However, in most of the cases, some additional material is needed to improve the mechanical properties of the soil. For those reasons, the construction must be carried out in a respectful way with the environment, fulfilling some technical requirements that facilitate and economise it.

The life and reliability of each construction depends on different factors. Starting from the determination of the properties of a material, to the computational model used and the capacity to describe accurately the described reality. Each of these factors carries some uncertainties given by the variability of the properties of the used materials, the natural variability of the processes and the human mistakes. Nevertheless, the modern methods in the numeric design, can respect and have influence on these uncertainties. For a correct statistical evaluation, is necessary an accurate model of the material and a suitable preparation of the material quantity. The elasticity module of the subsoil, is an essential characteristic of the material and it is a sensible parameter for the results of the tests. Specially, with the humidity and

density, and primarilly, it is sensible for the preparation of the samples in the laboratory (Ortiz, Ševelová, 2015).
This article presents the statistical processing of the results of the Resilient Modulus MR obtained in the laboratory carrying out the innovator CBR cyclic (Ševelová, Hauser, 2014).

Material and methods

Precising the thickness of the constructive layers and the supporting capacity of the layers is the key for a suitable design of them. To determine the thickness of these constructive layers, the mechanic behaviour of the soil material must be known. For that purpose, the resilient modulus will be calculated. The thickness of the constructive layers is determined in the same way that in the constructions of LVRs and in highways (TP 107, 2008). If this calculation is done suitably, the thickness of these layers will be optimized, and will be lead to save natural material and offer guaranties for the future.
The soil and materials for the constructive layers are natural materials, and their behaviour and variability of the mechanical properties affects not only in the classification, also in the humidity and density (Florian, Ševelová, Žák, 2015). Different soils have been analysed following the Unified Soil Classification System normative and the samples were analysed after, with the optimal humidity and maximum dry density (Hauser et al., 2018) according to the test Proctor Standard (ČSN EN 13286–2, 2005).

Test CBR cyclic

In order to calculate the resilient modulus, the innovator CBR cyclic test was used. Two precedents for the determination of the modulus have been introduced; the test with a constant penetration following the theory of Netherlands (Molenaar, 2009) and the modification of this method with a constant stress (Ševelová, Hauser, 2014).
The resilient modulus is the magnitude that quantifies the energy absorbed by a volume unit of a material. To calculate this parameter, in scientific world Hooke's law is used (Callister, William, 2005). This law tells that the deformation of a material is proportional to the tension that is subdue.
Hooke's law is used to calculate the elastic behaviour with static loads, but the calculus of the soil, as it is an application with cyclic loads, cannot be calculated by this law. For that calculus, the Molenaar method will be applied, which is based in the previously mentioned Hooke's law, and it is applied in the analysis of the soil. Previous investigations show the possibility of obtaining the estimation of the elasticity modulus, called effective modulus. The introduced data is obtained from the CBR test, more precisely the deformation. Following this theory (Molenaar 2009) the test CBR must be done with a constant deformation, also known as Test 2. However, the investigation carried out in Mendel (Ševelová, Hauser, 2014) is going further and is working on an innovator method for the calculation of the modulus.

Statistics

The soil is a material with several uncertainties, because of the mechanical properties of the soil vary in relation to the humidity and density (Pelikan et al., 2018). As the soil is exposed to whether changes, it is important to know in advance, how the modulus will behave, thus, a statistical model will be carried out.
Each kind of soil was analysed 6 times, and afterwards, a statistical analysis was performed calculating the average, the maximum the minimum and the median of different parameters of the different sections of the soil. The analysed parameters

were the maximum dry density, optimal humidity and the Resilient Modulus obtained in Test 2 and Test 3 with optimal and saturated humidity. Once these parameters were adjusted, the variability of the Resilience Modulus was analysed, meaning, the relation of the modulus with the change of the humidity and density. This relation is defined calculating the Pearson Correlation Coefficient (Achen, 1982). Pearson Correlation Coefficient is an index that measures the covariation grade between different linearly-related quantitative variables. The coefficient is an index whose values oscillate between - 1,0 and 1. When the value is near to 1, it means that the correlation is major, whereas it is minor, when the coefficient is near to 0.

Results

Once finished the statistical analysis, the obtained results have been analysed.
Different statistics parameters were set; the average, the maximum the minimum and the median. The table 1 represents this parameters for 11 types of soil in 51 samples. Each sample was repeated 6 times, so in total 301 cyclic tests have been done. The table 1 shows the correlation coefficient of Pearson that describes the correlation between the Resilient Modulus of test cyclic 2 (MR 2) with the humidity (w), maximum dry density of Proctor Standard. Also shows the relation between the number of cycles and the elastic deformation of the last cycle, that is where the MR modulus is obtained. To visualize better the results different graphics (1-6) are made, this graphics tells how the resilience modulus vary in relation with the humidity and the maximum dry density. In the graphics three of the analysed materials are represented and they have a typical behaviour of the representative materials (F8-CH, F6-CL, F4-CS). The tendency of the resilient modulus in relation with the humidity and the density for the soil in general is represented in the graphic 7 to 10.

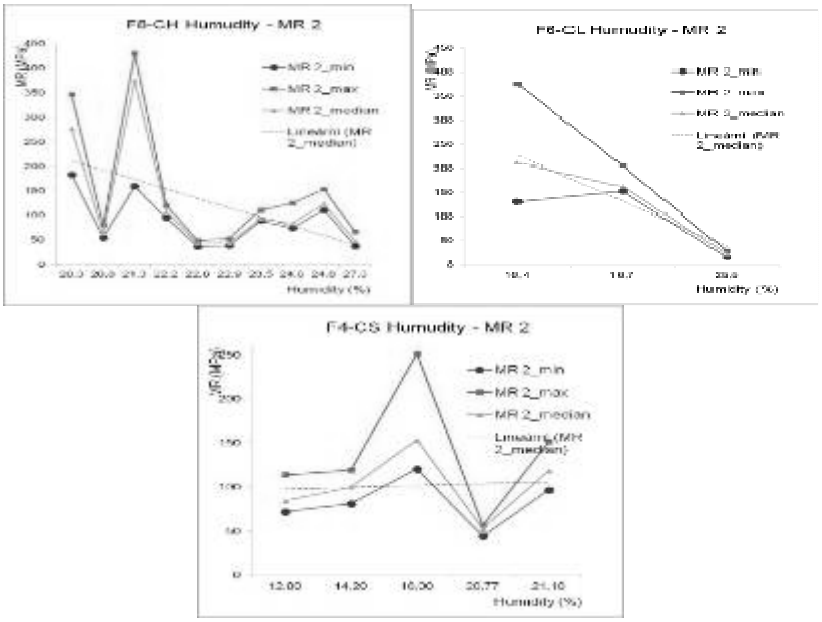

Fig. 2: Relation of the Resilient modulus with the humidity of soil F8-CH
Fig. 2: Relation of the Resilient modulus with the humidity of soil F6-CL
Fig. 3: Relation of the Resilient modulus with the humidity of soil F4-CS

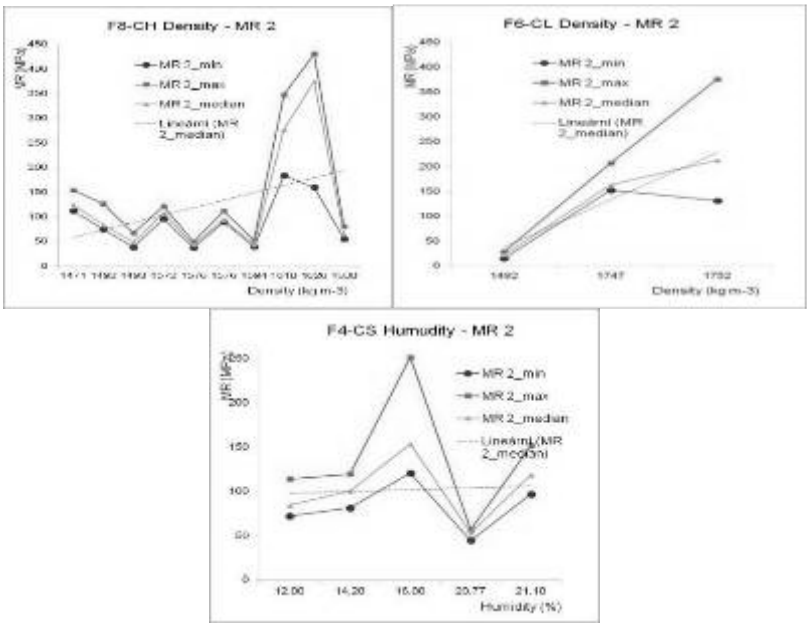

Fig. 4: Relation of the Resilient modulus with the maximum dry density of soil F8-CH
Fig. 5: Relation of the Resilient modulus with the maximum dry density of soil F6-CL
Fig. 6: Relation of the Resilient modulus with the maximum dry density of soil F4-CS

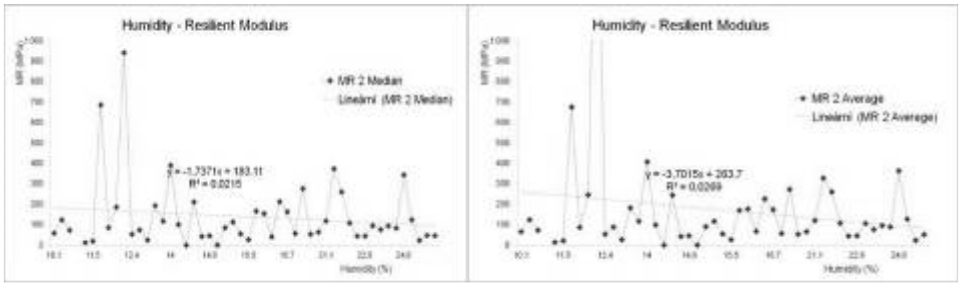

Fig. 7: The tendency of the Resilient Modulus in relation with humidity for the median
Fig. 8: The tendency of the Resilient Modulus in relation with humidity for the average

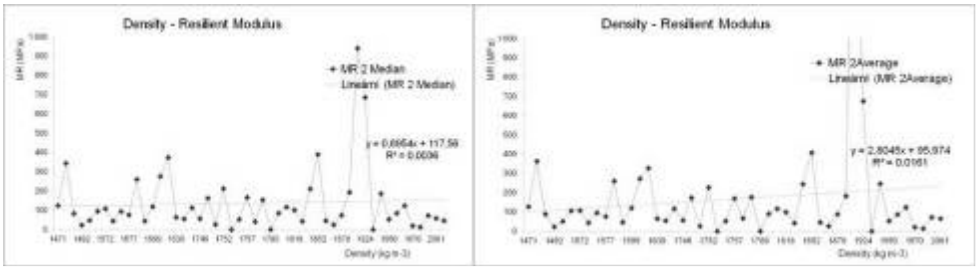

Fig. 9: The tendency of the Resilient Modulus in relation with density for the median
Fig. 10: The tendency of the Resilient Modulus in relation with density for the average

Tab. 3: Results of the statistical analysis

		Proctor standard		MR_T2_o				Pearson correlation coeficient		
		Humidity	Density	Min	Max	Average	Median	Humidity/	Density/	Cycle
		kgm -3	%	MPa	MPa	MPa	MPa	MR 2	MR 2	deformatio
1	F8-CH	1471	24,8	111,5	153,6	127,6	123,9	0,240	-0,222	0,583
2	F8-CH	1492	24,6	74,0	125,6	88,4	82,9	-0,385	0,354	-0,457
3	F8-CH	1626	21,3	159,2	429,9	327,9	374,2	-0,552	0,714	-0,855
4	F8-CH	1610	20,3	183,0	346,8	272,9	276,7	-0,028	-0,011	-0,767
5	F8-CH	1594	22,9	38,8	52,4	44,9	43,6	-0,026	-0,481	-0,309
6	F8-CH	1572	22,2	95,3	120,9	108,1	107,5	-0,551	0,476	-0,512
7	F8-CH	1576	23,5	88,6	111,1	95,2	93,2	-0,136	-0,497	-0,868
8	F8-CH	1576	22,8	36,9	48,6	43,2	43,1	0,071	0,210	-0,764
9	F8-CH	1630	20,8	54,6	79,4	64,5	63,7	-0,774	0,842	-0,828
10	F8-CH	1493	27,3	37,8	66,4	50,1	48,0	0,865	-0,840	0,298
11	F6-CI	1747	16,7	152,2	206,4	173,8	163,0	0,027	-0,119	-0,755
12	F6-CI	1752	16,4	130,6	375,9	226,5	212,2	-0,799	0,789	0,593
13	F6-CI	1492	25,5	14,9	28,0	21,9	22,2	0,010	0,631	-0,842
14	F5-ML	1780	15,1	-	-	-	-	-	-	-0,438
15	F5-ML	1746	20,2	46,9	64,5	56,2	55,5	-0,257	0,395	-0,188
16	F4-CS	1778	16	120,2	250,8	177,2	153,2	-0,624	0,507	-0,683
17	F4-CS	1818	14,2	80,9	119,1	98,9	100,0	0,430	-0,618	-0,462
18	F4-CS	1935	11,4	-	38 518,4	11 936,6	8 823,2	-0,369	0,359	0,690
19	F4-CS	-	-	71,8	113,6	86,2	84,2	-0,768	0,738	-0,568
20	F4-CS	1599	21,1	96,5	151,0	120,4	118,3	0,512	-0,111	-0,921
21	F4-CS	-	-	44,2	56,5	51,8	52,8	0,386	0,500	-0,688
22	F3-MS	1782	15,3	69,2	123,5	89,7	85,2	0,842	0,031	-0,643
23	F3-MS	1969	10,8	105,6	139,2	124,3	124,3	0,889	-0,729	-0,595
24	F3-MS	1862	13,3	10,7	40,5	25,5	23,7	0,031	0,003	-0,538
25	F3-MS	1832	14,5	29,3	57,7	41,9	41,6	0,723	-	-0,634
26	F3-MS	2013	10,9	57,5	86,5	72,0	71,6	-0,279	-	-0,619
27	F3-MS	1578	21,4	192,1	330,7	260,9	259,7	-0,755	-0,184	0,667
28	F2-CG	1548	23,1	62,4	196,1	106,3	95,4	-0,442	0,361	-
29	F2-CG	1475	24,6	181,3	571,9	362,4	342,8	0,471	-0,412	0,290
30	F2-CG	1577	23,1	58,3	90,8	75,5	75,1	-0,147	0,058	-0,132
31	F2-CG	-	-	41,8	55,3	46,9	45,9	-0,314	0,234	-0,713
32	S5-SC	2061	10,1	26,8	108,6	64,1	57,5	0,488	-	0,089
33	S4-SM	1881	13,3	137,3	202,3	181,6	192,3	-0,437	0,570	-0,477
34	S4-SM	1847	14,4	131,1	410,2	243,7	211,0	0,711	-0,725	-0,427
35	S4-SM	1878	12,9	47,9	155,7	88,6	74,6	0,081	-0,218	0,636
36	S4-SM	1757	15,7	138,0	199,2	169,1	166,5	-0,393	0,434	-0,222
37	S4-SM	1860	14,6	23,1	69,7	45,7	46,1	-0,130	0,491	0,009
38	S4-SM	1708	15,4	29,4	83,7	54,6	53,6	0,050	-0,128	0,588
39	S4-SM	1852	14	170,3	710,7	407,4	389,4	-0,422	0,710	0,292
40	S4-SM	1924	11,9	391,1	913,6	675,7	685,7	-	-	-0,796
41	S4-SM	1938	12	138,7	507,1	246,2	184,6	-0,606	0,484	-0,280
42	S4-SM	1751	15,5	19,0	30,7	25,7	25,6	-0,082	-	-0,691
43	S3-SF	1723	15,3	96,0	146,8	117,1	112,2	0,050	0,104	-0,343
44	S3-SF	1784	13,4	67,4	168,7	116,8	116,6	0,450	-0,586	-0,248
45	G5-GC	1889	12,3	406,1	7 326,2	2 154,3	941,0	0,487	0,118	0,958
46	G5-GC	1840	12,4	-	50 634,6	29 824,9	-	-0,099	-0,117	0,054
47	G5-GC	1754	14,2	-	-	-	-	-	-	-
48	G4-GM	1988	11,5	9,0	22,9	13,8	12,6	0,468	-0,435	-0,503
49	G4-GM	1970	11,5	16,0	24,3	19,7	19,3	0,195	-0,078	-0,132
50	G4-GM	1950	12,4	40,1	64,1	52,3	53,0	0,035	-	-0,219
51	G4-GM	1769	16,2	32,0	180,2	67,5	39,3	0,611	-0,055	-0,085

Discussion

The tendency represented for the 7 to 10 graphics, with median and the average shoes the elastic behaviour in relation with the humidity and the density. At the same time, it is possible to see that the tendency is not domineering but some values of the modulus leave out of the habitual borders. For that reason, is necessary to increase the number of samples to confirm that exist the correlation between the resilient modulus and the humidity or density, and how it is seen some materials have the expected behaviour.

Conclusions

Although the digressions of the expected behaviour, the determination of the modulus of the test cyclic CBR continuous being the most prominent tool to describe the elastic behaviour of the unstable materials for LVR. Now is not possible to do a reliable design with high quality without using numerical computational models. An accurate determination of the characteristics of the required material, in particular the elastic modulus of the subsoil, that respond accurately to the changes of the humidity of the soil while is compatible with the numerical model used.

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Souhrn
Nízkokapacitní vozovky LVRs zahrnují jak cesty účelové, vozovky lesní a polní dopravní sítě, tak i komunikace využívané k volnočasovým aktivitám. Hospodárný a spolehlivý a také ekologicky šetrný návrh je závislý na mnoha faktorech, které vnáší do procesu náhodné proměnlivosti vlastností. Chceme-li zahrnout tyto vlivy do optimalizace návrhu, je nutno pracovat s výpočetními numerickými modely, které vyžadují výstižné stanovení potřebných materiálových charakteristik, zvláště modulu pružnosti podloží, jenž je zásadní materiálovou charakteristikou citlivou dle výsledků testů zejména na vlhkost a objemovou hmotnost. Těmto požadavkům vyhovují moduly pružnosti (Resilient modulus MR) stanovené z cyklických zatěžovacích zkoušek, při kterých je simulováno zatížení opakující se dopravou. Příspěvek předkládá statistické zpracování laboratorních výsledků modulu pružnosti MR (Resilient Modulus) podloží z inovativního cyklického CBR testu, který je testován a analyzován pro potřeby praktického využívání v procesu navrhování, v laboratoři Mendelovy Univerzity v Brně. Jak dokládají prezentované výsledky modulu MR, stanovené z 301 vzorků deseti různých zemin, je trend pružného chování z této inovativní cyklické zkoušky v závislosti na optimální vlhkosti, resp. objemové hmotnosti sušiny ze zkoušky Proctor standard, klesající resp. rostoucí a odpovídá očekávaným předpokladům. Současně je patrné, že hodnoty modulu z některých zkoušek výrazně přesahují předpokládané hodnoty a hodnota trendu tak není dominantní. Navzdory odchylkám oproti očekávanému chování, splňuje chování v závislosti na vlhkosti, resp. objemové hmotnosti předpoklady a stanovení modulu z cyklického CBR testu odpovídá nárokům na popis elastického chování nestmelených materiálů pro LVRs pro numerické modelování. Pro další použití bude ale nutno vztáhnout hodnoty modulu MR k reálným hodnotám vlhkosti a objemové hmotnosti z vlastní cyklické zkoušky, nikoli k hodnotám ze zkoušky Proctor standard a provést další srovnání.

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THE USE OF PHOTOGRAPHY IN ENVIRONMENTAL EDUCATION

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Abstract
Photography contains a great potential for personality development which can be used for environmental education at all levels of school and out-of-school education. This paper deals with relevant concepts in this context and examples of practical applications in environmental education. With the development of digital photography its price have been reduced and its availability have been growing, which brings us a wealth of our own and other people´s photographs, which is a valuable material bearing the imprints of our lives, wishes, emotions, attitudes and/or evocative associations that we feel seeing them. In psychology we have already encountered fields such as phototherapy and therapeutic photography. However - how is discussed in this paper - we do not have to talk directly about therapy, and yet we can use photos for education so that participants learn more about their environmental preferences and about their influence on their own environmental behaviour.

Key words: personality development, environmental behaviour, phototherapy

Introduction

The first known photo was created in 1822 by the French inventor Nicéphore Niépec. Since then technology has changed significantly, as well as its availability. Nowadays, more than 99% of photos all around the world are taken with digital cameras[23] and the share of digital images coming from smartphones is growing (Peres, 2008). Availability and broad popularity of photography can be used for education as well for as personality growth, and therefore also for environmental education.

The pictures that we capture (and with the use of a projection also photos taken by other people) reflect our memories, feelings, values and wishes. It give us the opportunity to bring back our past, rebuilt it and at the same time reflect it, understand its meaning and sense and also think about future events.

The world of our inner feelings as well as the structure of our system of values, subconscious and unconscious impulses and influences is hardly accessible to our conscious sphere and verbal communication. Projective methods are one of the ways how to uncover our hidden motives, how to realize our feelings and preferences and how to enhance the personality consistency through entertaining creative activities. Thus, photography offers valuable material not only for therapeutic purposes but also for educational work that can be successfully applied to environmental education.

[23] The development of digital photography and its specifics is reflected also in relevant literature (e.g. Del Loewenthal: Phototherapy and Therapeutic Photography in a Digital Age, 2013).

Materials and methods

This paper is based on the overview of relevant written sources which form the platform for suggesting practical exercises for the individual and group work with photography with the aim of personal growing, e.g. self-reflection and understanding of own environmental preferences and behaviour as well as increasing own motivation in this field.

Theorethical background

Photography is a medium of *"recording, presenting and preservation of images of people and their social world"* (Szompa, 2008, p.125). The photos allow us to immobilize and capture moments that will be never repeated, and they can - in the case of our private photos - evoke in us positive or negative emotions that were connected with the moments, or - in the case of foreign photographs - evoke associations related to our emotions, experiences, values and attitudes. Very important is also the process of making photographs itself, which (if not done thoughtlessly) forces us to think, to perceive reality more intensively and to evaluate and re-evaluate it and to integrate parts into the overall structure of our memory, value and personality system, which create a great potential for using photography in psychology.

In the literature we encounter methods such as phototherapy and therapeutic photography[24], which belong to the methods of art therapy[25], and which use projection; but they do not work only with verbal communications but they use art (in our case, photography) as the main mean of therapy or of self-knowledge and personality development, which can be successfully used also for environmental education.

According to the U.S. Environmental Protection Agency the components of environmental education are[26]:

- Awareness and sensitivity to the environment and environmental challenges;
- Knowledge and understanding of the environment and environmental challenges;
- Attitudes of concern for the environment and motivation to improve or maintain environmental quality;
- Skills to identify and help resolve environmental challenges;
- Participation in activities that lead to the resolution of environmental challenges.

All of these components can be used for environmental education with the use of photography. As noted above in psychological work with photographs we can distinguish two basic directions, namely phototherapy a therapeutic photography (Weisser,1999).

[24] PhotoTherapy, Therapeutic Photography, Photo-Art-Therapy, VideoTherapy and other related techniques are connected mainly with Judy Weiser - the founder and director of the PhotoTherapy Centre in Vancouver.

[25] From the historical point of view, art therapy is a relatively young discipline whose beginnings go back to the last century, when this term began to be used in Europe. However, the term "art therapy" was used for the first time in the 1930s by Margaret Nauburgh in the United States (Šicková-Fabrici, 2002).

[26] What is Environmental Education? [Online] [cit. 2018-03-25]. Available from: <https://www.epa.gov/education/what-environmental-education>

Phototherapy is a psychotherapeutic method that should be conducted exclusively by a professional psychotherapist. The goal is to process unconscious content and achieve deeper changes in personality. The main founders and representatives of this specialization, which has been developing since the 1970s in Canada and America, include personalities such as Entin, Fryrear, Gassan, Hogan, Krauss, Stewart, Walker, Weisser, Wolf, Zakem. (Weisser 2009 in Vítečková 2009). PhotoTherapy techniques are therapy practices that use people's personal snapshots, family albums and pictures taken by others (and the feelings, thoughts, memories, and associations these photos evoke) as catalysts to deepen insight and enhance communication during their therapy or counselling sessions (conducted by trained mental health professionals), in ways not possible using words alone.[27]

Therapeutic photography[28] uses the photography primarily as a mean of self-knowledge, self-reflection, self-expression and personal growth. It originated in England at about the same time as phototherapy. It is associated with the names of J. Spence and R. Martin. It is a tool that can be used in education, health, social work, coaching or helping professions. Although the relationship to counselling skills is significant too, it does not assume the use of psychotherapeutic approaches and a deeper "dive" into an individual's personality. It is close to supporting and coaching and the possibilities of use can be seen in personality and social education as well. (Weisser 2009 in Vítečková 2009). The change is one of the main goals of personality growth and coaching and photography can support process of change; according to Craig (2009, p. 30.): *„Images can simultaneously reflect and promote change. They offer a starting point in the process by the identification of goals and a means to create a concrete representation of what the person or group is seeking to achieve. Milestones along the way may also be presented visually providing tangible steps to work towards, aiding planning and offering a means to measure progress… the image-making process has the added advantage of being able to record change which, in turn, offers a source of motivation, demonstrating the full extent of the distance travelled. Photography is therefore a perfect medium to use with groups of people who wish to effect some form of positive change in their lives."*
One of the main benefits of using photography for psychological work with clients is its availability, popularity, ease of image taking (unlike other art therapy techniques that may seem to be very difficult for many people). The following part of this paper outlines examples of practical techniques for practical use of photography for environmental education.

Results and Discussion – Examples of practical application
This section presents examples of five specific techniques (based on author´s experiences) using photography for environmental education. Techniques include the development of environmental sensitivity and the development of environmental protection activities. For each technique is stated the objective, a brief description and its most important pitfalls and limits.

Environmental problems in our neighbourhood:
The objective: Focus the participants' attention on environmental problems in a given location; set their perception to a different viewing angle.

[27] **PhotoTherapy, Therapeutic Photography, & Related Techniques [**Online] [cit. 2018-03-18]. Available from: https://phototherapy-centre.com/
[28] The practical activities outlined in this paper use mainly approaches of therapeutic photography.

The activity description: Participants shoot independently a series of photos on the topic of this activity in the selected location. The following part is a discussion with comments for each photo; using group facilitation techniques the participants try to set environmental priorities, controversial and marginal themes of this location.
The pitfalls and limitations of the method: Determining the issue of environmental consequences that be opened during the discussion may exceed the expertise knowledge of the participants and the lecturer. (Participants should be aware of this fact as well as of the volatility of some scientific knowledge.)

Environmental activist:
The objective: To lead participants to their own activities related to environmental protection.
The activity description: Participants take photos of environmental issues that they would like to eliminate by their own forces in the selected location. This activity continues with is a presentation in front of a group with the discussion. After that, participants have a certain amount of time (week, month ...) to accomplish their task. They photograph the final state they have achieved (or have not reached) by their own power and this activity is again ended with a group discussion.
The pitfalls and limitations of the method: Establishing unrealistic and costly goals and overlooking minor problems, or vice versa, setting too simple or absurd tasks (both should be solved in the first group discussion).

Gone with the wind:
The objective: To develop the perception of the changes of the environment over time and to consider possibilities of eco protection; awareness of own environmental memories and eco-motivation.
The activity description: Participants recall the place in nature that they liked and which was destroyed later. If possible, they bring old photos of the original state of this place (or they try to get photos of a similar place) and new photos documenting the devastation of this place. Following is a group presentation and discussion focused on their feelings, memories, environmental changes and conservation.
The pitfalls and limitations of the method: More demanding preparation of participants (it is not always possible to find photos capturing the original state of "their" place); distinguishing between naive and realistic ideas and options in the discussion; opening too personal memories and issues in the discussion.

"Charging and discharging batteries":
The objective: Recognize the impact of the environment and surroundings on own personality.
The activity description: Participants capture places which give them energy and places which take their energy away. This activity can be followed by an individual session with a lecturer or by a group presentation in which participants try to find common and different motives in their pictures and experiences.
The pitfalls and limitations of the method: The task may appear too difficult for some participants and the result may also be influenced by their current psychological state (the participants should aware of it).

The hidden beauty around us:
The Objective: To increase the sensitivity of the participants in perceiving their surroundings and to learn to appreciate the little environmental beauties.

The activity description: Participants are assigned to take photos of everything they think is beautiful in their location; they try to find especially the details that they did notice before this task. This activity can be finished with an individual interview with a lecturer or with a group presentation and discussion. The theme of conservation of these beauties should be also included.
The pitfalls and limits of the method: Differences in participants´ ability in beauty perception can be a good topic for discussion but also the source of misunderstanding.

Conclusion
Photography is currently very popular, available and easy activity that has a great potential for psychotherapeutic use as well as for personality growth techniques, including environmental education. This paper outlined the theoretical background of this area and brought examples of five specific techniques with the stated aims, brief descriptions and with their pitfalls and limitations. I believe this paper will be an inspiring source for the practical use of photography in environmental education.

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Souhrn
Fotografie v sobě nese velký potenciál osobnostního rozvoje, který lze využít pro environmentální vzdělávání na všech úrovních školního i mimoškolního vzdělávání. S rozvojem digitální fotografie se snížila její cena a výrazně zvýšila její dostupnost, což nám přináší nepřeberné množství vlastních i cizích fotografií, které jsou cenným materiálem nesoucím otisky našich životů, přání, emocí, postojů a/nebo vyvolávajícím asociace, které při pohledu na ně pociťujeme. V psychologii se setkáváme již s obory jako je fototerapie a terapeutická fotografie. Nemusíme však mluvit přímo o terapii a přesto můžeme s fotografií pracovat tak, aby si účastníci vzdělávání uvědomili svoje environmentální preference a jejich vliv na jejich vlastní chování ve vztahu k prostředí. Tento příspěvek se zabývá jak relevantními koncepty, tak návrhy příkladů praktické aplikace v environmentálním vzdělávání. V příspěvku

jsou uvedeny příklady pěti konkrétních technik (vytvořených a okomentovaných na základě zkušeností autorky) využívajících fotografii pro environmentální výchovu. Techniky zahrnují jak rozvoj environmentální senzitivity, tak rozvoj vlastní aktivity v souvislosti s ochranou životního prostředí. U každé techniky je uveden cíl, stručný popis provedení a její nejdůležitější úskalí a limity.

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TIMBER AND WOOD PRODUCTION IN TROPICAL AFRICAN VIRGIN FORESTS

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Abstract
African Tropical natural forests have played an important role to the global ecosystem, human survival, and natural diversity for decades. They equally provide a great deal of heritable diversity such as medicinal plants, high quality food and various additional useful products both non timber, and wood timber. The region has been in the lead in production and exportation of hard and quality wood of species for example; African ash, African Teak, African mahogany, Afrormosia, African Cherry, and the Utile.
Our study is focused on analyzing the trend in forest wood and timber production and export in combination with the trend in deforestation processes in Tropical Africa. A statistical examination of the linkages between tropical timber production, and deforestation.
Findings demonstrate a linear increasing trend in both production and export of major forestry products, and continuous decrease in the coverage of the natural rain forests. We recommend that interest in nature, technology and development, economics and finance, and legislation for natural forest conservation be taken seriously and as a matter of urgency in the region.

Key words: lumber, wood fuel, deforestation, economy, ecology

Introduction

Tropical Africa (TA) is highly endowed with natural and ever green broad leaved forests. These forests play a paramount role to the global ecosystem, human survival and natural diversity. The Tropical African region is a home to the world's rarest species of birds, animals, trees and shrubs (Bamwesigye & Hlavackova, 2017). This makes the region one of the globe's diversities such as medicinal plants, high quality food, water shed system with various natural rivers and inland lakes, and numerous valuable products mutually non timber, and wood and timber (Horák, Simonová, & Messari, 2017, Klemperer, 2003)
TA forest range is a home to various indigenous peoples such as the Batwa of Central and East Africa, and a basket of natural products. It as well provides vigorous ecosystem services, such as flood protection, and soil conservation. The regional forests also have an utmost important effect on carbon and climate (Laurance, Alonso, Lee, & Campbell, 2006). This forms the global forest functions i.e. economic, social and ecological uses of forests at various levels of development (Klemperer, 2003).
Although much of the wood goes to wood fuel and wood charcoal (Bamwesigye, Darkwah, Hlaváčková, & Kupcak, 2017), the regional growth domestic product (GDP) referred as contribution to national and or regional economic activities and revenues reaps highly from the wood timber business (Sujová, Michal, Kupčák, & Dudík, 2017). Additionally, non-timber and non-wood products also fetch huge sums

of money for both national treasuries and individuals such as tourism and recreation (Bamwesigye & Hlavackova, 2017), food, and medicine.
The region takes a lead in the production and exportation of hard and excellence wood species such as the African ash (Pterygota macrocarpa), African mahogany (Khaya grandifoliola), African Teak (Chlorophora excelsa), Afzelia (Afzelia bipindensis), Utile (Entandrophragma utile), Afrormosia (Pericopsis elata), African Cherry (Prunus africana) among others. The major regions in Tropical Africa include West Africa composed of mainly Nigeria, Ghana, Gabon, and Cameroon, and the Central African region composed of Democratic Republic of Congo (DRC), and lastly East Africa consisting of Uganda, Tanzania, and Kenya as the chief producers and exporters of timber and wood. The chief export destinations are the European Union, and china.
Wood production and consumption have been increasing in Tropical Africa over the decades. This is attributed to the rapidly growing population on the block. Majority of the wood and timber producers are secluded proprietors and companies. Nevertheless, the mainstream of sawn timber production is based in the forest reserves. Domestic wood consumption in the region is also high due to demand for building materials, furniture, and wood fuel for both domestic and some factories. The entire African region has a huge dependence on wood fuel as well as wood charcoal. Wood charcoal production and utilization is the principal wood consumer in the formal and informal market (Bamwesigye, Darkwah, Hlaváčková, & Kupcak, 2017, Kanabahita, 2001). The wood fuel demand is growing at a very fast rate due to higher demand than for any other fuel sources on the African continent.
We examine the trend in forest wood and timber production, and deforestation in Tropical Africa. We highlight major issues surrounding tropical forest development in Africa as well as propose some policy recommendations for decision making at numerous levels of leadership in the region.

Material and methods

The study acquired considerable information from scientific sources such as journal articles, web pages, scientific conference proceeding, and data banks, for example;
The Food and Agricultural Organization (FAO), data on timber production from 1970 to 2016 for Africa, East Africa and the West African regions which for the Tropical African region of Africa. The data included; round wood, industrial round wood, sawn wood, saw logs and veneer logs, wood pulp, wood fuel, and wood charcoal (FAOSTAT, 2018). Also, data from global forest watch used for our study.
A blend of qualitative and quantitative methodologies (Creswell, 2009) was mutually used to analyze the information and the data (Punch, 2009). Quantitative data was studied using descriptive statistical analysis (Klotzbaugh & Glover, 2016). Similarly, numerous graphs, maps and photographs ranging from forest cover and loss, timber and wood of tropical origin were obtained and studied to demonstrate the situation and reality about timber wood, and wood fuel and charcoal, and deforestation in the region (figure 1).

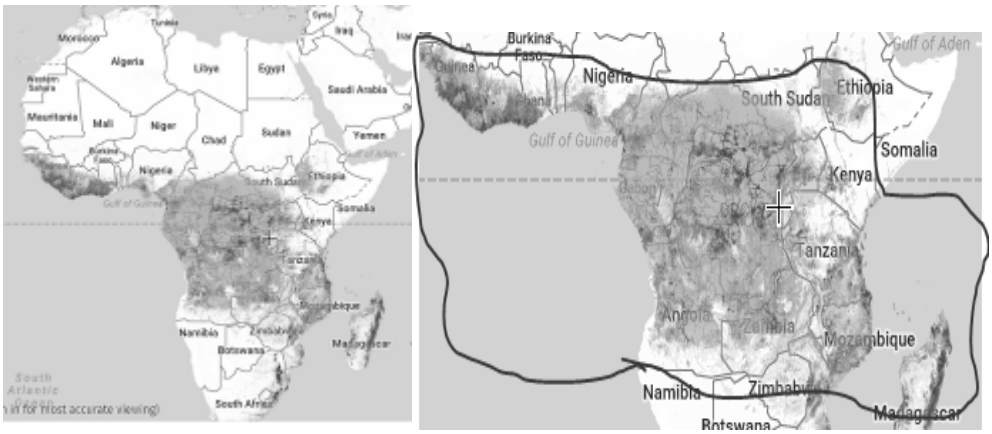

Fig. 1: Area under study (marked with red line): Location of Tropical African region in Africa. (Green color: forest cover; Purple color: forest loss)
Source: Global Forest Watch

Also, specific countries; Gabon, Democratic Republic of Congo (DRC), Uganda, Cameroon and the Central African Republic were given special attention due to their availability of data, and also forestry development opportunities and challenges they are facing.

Results and Discussion

Forest change in the region i.e. tree cover gain, and tree cover loss indicates that there exists a loss above 30% canopy density of the virgin forests even though the whole of this loss is not always a product of deforestation (figure 1). The green and purple colors in the map of Tropical African region represent tree cover and tree loss respectively.

The tree loss is majorly attributed to logging for timber and wood fuel regarding the high demand for lumber and timber in the region and export market for the hard wood. Wood fuel and charcoal are the primary sources of the region hence the escalating demand for the product (figure 2).

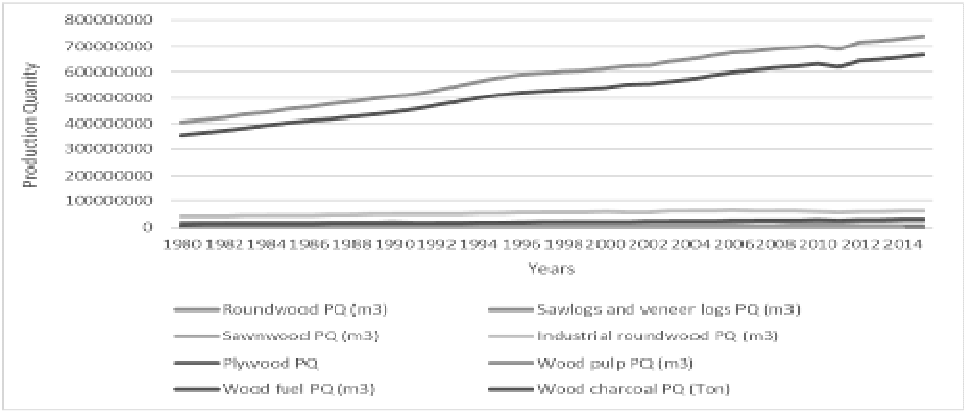

Fig. 2: Trend of production for the various wood products in Africa in general
Source: FAOSTA, authors' analysis

The utilization of the famous tropical rain forests has over time become a victim of numerous factors (Laurance, 1999, Laurance, Alonso, Lee, & Campbell, 2006) leading to a trend referred to as deforestation. i.e.

1. Logging and export, this is illustrated by findings from various data banks for the different wood products. This is both legal and illegal logging which is triggered by both high demand due to lucrative business for the hard and durable wood, and poverty in the region.
2. Increasing population, there is a shooting population on the block, which has grown by more than 60% in the last 30 years (FAOSTAT, 2018).
3. Limited energy alternatives on the block. Even though Africa has vast rivers and great water falls, hydro-generated power cannot match even a quota of the bolds demand for electricity hence huge dependence on wood fuel and charcoal fuel (figures 2 & 3) Bamwesigye, Darkwah, Hlaváčková, & Kupcak, 2017.
4. Weak government policies and interventions; Timber and wood production under legal logging greatly contributes to the economic growth of many national economies in the Tropical African region through employment, small businesses, taxes and logging fees (Sujová, Michal, Kupčák, & Dudík, 2017). Illegal logging persists in the region and this is attributed to the nature of some of these forests which are impenetrable hence difficult to track and monitor illegal loggers.

According to the Global Forest Watch, 2018, and (Figure 1) there is a remarkably vivid forest loss in the entire tropical region of Africa (Fingure 2 & 3) which is illustrated by the trends herein. Our study supports previous arguments about huge dependence on wood fueel and charcoal in Uganda and the region (Bamwesigye, Darkwah, Hlaváčková, & Kupcak, 2017). Their study mutually illustrated a double edge sword about some of the causes of deforestation such as woodfuel and charcoal production as it doubles as a source of livelihood for many households in tropical Africa both rural and Urban. Further more, they argued that climatic change, agriculture failure and food insecurity, and increasing poverty are highly linked to deforestion whose increasing trend matches with the impacts mentioned herein.
According to FAO 2018, DRC, Gabon, Cameroon, Central African Republic, Uganda are the most deforested states. This is largely due to illegal logging and huge demand for household and industrial wood fuel.

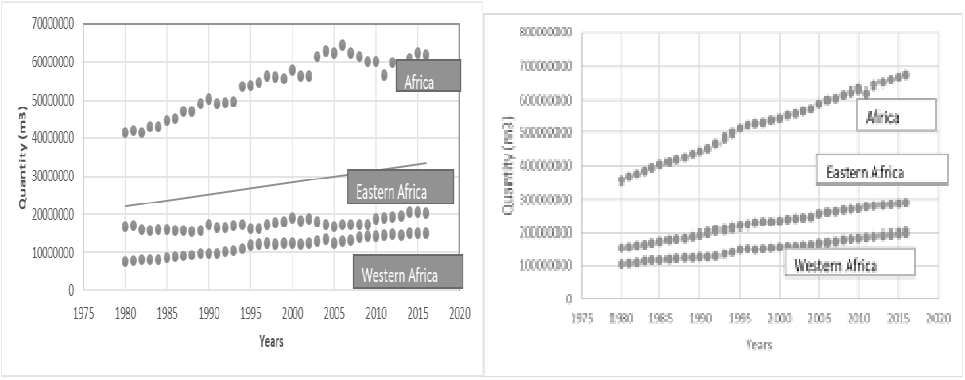

Fig. 3: Industrial round wood, and wood fuel production 1980-2016 respectively.
Source: FAOSTA, authors' analysis

Conclusion

The time series analysis shows an increasing positive linear and worrying trend across the major wood and timber products such as round wood logs, industrial wood, and wood fuel and charcoal wood across the tropical region of Africa.

There is a huge tree cover loss illustrating loss over 30% canopy density. The trend in industrial logging in the region is increasingly leading to mass deforestation and loss of forest biodiversity.

The study identified four major causes of deforestation in Tropical Africa as; industrial logging, a rapid population growth, limited energy alternatives, and weak government policies and intervention.

We propose that the governments in the region take natural forests seriously since little is left. Financial and technological investment for energy alternatives, local communities livelihood programs, and monitoring and reporting logging should be put in place to reduce on deforestation.

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Souhrn

Naše studie zkoumala trend lesního dřeva a dřevařské výroby a odlesňování v tropické Africe. Identifikovali jsme čtyři hlavní příčiny odlesňování v tropické Africe; průmyslové těžby dřeva, rychlý populační růst, omezené energetické alternativy, tudíž tlak na palivo z dřeva a uhlí a slabé vládní politiky a intervence.

Navrhujeme některé politické doporučení pro rozhodování na mnoha úrovních vedení v regionu.

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TO ASSESS OR NOT TO ASSESS? – THE IMPORTANCE OF GEOSITE ASSESSMENT BASED ON VISITOR PREFERENCES FOR NATURAL-BASED TOURISM FORMS DEVELOPMENT

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Abstract
Various geosite assessment models/approaches have been introduced in last three decades in order to determine the value of the specific location of natural heritage, especially geosite and/or geomorphosite. The value of an individual geosite reflects the information on selected characteristics of the site based on the criteria used within the assessment method. From a scientific point of view, it represents a very important tool to know the values of the natural heritage sites for conservation or protection purposes. Respecting recent growing demand for recreation and time-spending in the natural environment gives an opportunity to use the assessment method(s) for various natural-based tourism forms development. However, criteria and the overall approach to the assessment of geosites do not, or just marginally, reflect the real requirements that should be taken into account when considering utilization of geosite assessment for natural-based tourism forms development and management as presented in this paper.

Key words: geosite value, assessment, geotourism, visitor, preferences

Introduction

Geosite assessment or evaluation models have been introduced by various authors in last decades, as summarized by, e.g., Kubalíková (2013), Różycka and Migón (2014), Štrba et al. (2015) or Suzuki and Takagi (2018),. In general, they can be divided into two major groups: (1) qualitative assessment models, and (2) quantitative assessment models.
As summarized by Štrba et al. (2015), both above-mentioned approaches give useful information on the value specific geosite. However, results of quantitative are more applicable for further management and planning of development related to assessed geosite. On the other hand, it should be mentioned that geosite assessments, in most cases, are strongly scientifically based. So, the application of the assessment results within tourism products development is very limited or absolutely impossible.
This article focuses on an alternative view on the geosite assessment taking into account one of the most important requirements of not only natural based but any tourism form – visitors. Focusing on visitor preferences and/or motivation (Štrba et al. 2016a, Štrba 2018) to visit specific geosites may significantly affect the success and sustainability of various natural-based tourism forms, primarily represented by geotourism and ecotourism.

Geosite and geosite assessment models

Geosite can be described as a unique natural phenomenon representing one or several specific features related to geological and/or geomorphological processes. It is often understood as geo(morpho)logical heritage, or simply geoheritage. The term ‘geosite’ has been discussed by various authors, professionals especially in the field

of geology and geomorphology. Recently, the clearest and most precise explanation (definition) of the term geosite has been given by Reynard (2004), saying that:
"Geosites are portions of the geosphere that present a particular importance for the comprehension of Earth history. More precisely, geosites are defined as geological or geomorphological objects that have acquired a scientific (e.g. sedimentological stratotype, relict moraine representative of a glacier extension), cultural/historical (e.g. religious or mystical value), aesthetic (e.g. some mountainous or coastal landscapes) and/or social/economic (e.g. aesthetic landscapes as tourist destinations) value due to human perception or exploitation."
Various assessment models were primarily defined to set the value of geosite or geomorphosite and addressed to professionals in the field of geology, geomorphology, geoheritage protection, and conservation. Following text brings brief overview of various geosite assessment methods, often mentioned in various geosite related publications, including methods introduced by Pereira et al. (2007), Reynard et al. (2007), Bruschi et al. (2011), Vujičić et al. (2011), Fassoulas et al. (2012)
An assessment method of Pereira et al. (2007) is based on very detailed procedure comprising of scientific values, added values, geomorphological value, values of use, protection value, and management value giving in final very complex evaluation score.
A method of Reynard et al. (2007) includes two major criteria categories – (1) scientific value, taking into account integrity, representativeness, rareness, and paleogeographical value, and (2) additional value.
Bruschi et al. (2011) introduced an assessment method based on three groups of criteria: intrinsic quality (scientific value), the potential for use (economic value), and potential threats and protection needs. These three groups include 21 assessment criteria. Similarly, Fassoulas et al. (2012) proposed an assessment model based on statistical methods. According to Štrba et al. (2015), "*this method can be considered as the most objective but in terms of practical use, it is relatively complicated to use this method on a large number of sites in general due to the fact that it is necessary to ask several independent experts dealing with the problems. In some regions, it can comprise a problem from personal as well as from professional point of view*". However, a large number of criteria used within an assessment method may give a very complex view on the value of assessed objects what can be used, with more or less limitation, for various purposes, including nature-based tourism forms development and/or destination management (Štrba et al. 2017a).
Vujičić et al. (2011) have chosen an alternative approach. Their geosite assessment model (GAM) is based on previously defined assessment method. So, it has adopted many of assessment criteria grouped within five general categories: scientific value, aesthetic value, protection, functionality, tourist value. The result of this assessment is in the form of two numbers ("coordinates") specifying the position of assessed location within the assessment graph. The graph is divided into nine fields. Each field has specific recommendations on further action. However, these recommendations are quite brief and should be explained in more detail for wider use of this method.
In general, it can be assumed that there are some assessment categories or criteria used within almost each quantitative assessment method (Kubalíková 2013, Štrba et al. 2015). They include: safety rarity, representatives, integrity, accessibility, ecological value, and economic value.

Discussion on the importance of visitors' data

Selection of an individual geosite assessment method is just one part of the problem. Qualitative assessment methods result in some kind of text describing the value of the geosite. Such kind of text is barely usable by local tourism stakeholders or managers in the process of natural-based tourism forms, e.g., geotourism, development. Qualitative geosite assessment methods result in an individual score or a set of numbers/scores. Again, what does the number say? For example, a selected geosite assessment method gives a result of the geosite final score: 5.5, meaning national significance of the locality. What does the number say to tourism manager, stakeholder, geosite visitor, etc.? Of course, it gives very important information on the locality but from scientific and to tourism potential point of view.

Moreover, when discussing geosite assessment and potential tourism development, a specific tourism form where these methods can be used should be defined. In our case, geotourism plays a primary role. Geotourism, similarly to other nature-based tourism forms (e.g., ecotourism), is globally growing phenomenon (Dowling 2011). This concept is mostly developed in geoparks.

Geotourism itself, as a tourism form, has been discussed by many authors for several years and is still a subject of discussion, as there are two major understandings of geotourism nature. The first approach is based on the geological character (e.g., Hose 1995, Newsome & Dowling 2010, Hose 2012) and the second focuses on the geography of the area (National Geographic 2006). The Arouca Declaration (2011) tries to combine both approaches into one definition. However, according to Hose (2016), this definition fits more ecotourism than geotourism.

Beyond the nature of geotourism and its understanding, it is a natural-based tourism form. Moreover, like any other tourism form, it strongly depends on the visitors and their interest to undertake geotourism, or nature-based tourism, experience. But, there is a very lacking number of publications presenting research results focused on geotourism or any other nature-based tourism form participants. From development and sustainability point of view, this is a very crucial point. When combining recreation and environmental protection, as, within geotourism or ecotourism, data on tourists should play a key role to ensure sustainability of such products.

According to Dowling (2011), discussing geotourism principles, this tourism form is: (1) geologically based, (2) sustainable, (3) locally beneficial, (4) geologically informative, and (5) brings tourist satisfaction. Here, at least two principles require data on tourists or potential visitors to ensure the success and sustainability.

Recently, the most effective tool to collect, sort, analyze and use visitors' data for decision-making, future planning and management within tourism is represented by smart destination systems or platforms (e.g., Fuchs et al. 2013; Kršák et al., 2015; Štrba et al. 2016b). Implementation of data on the value of natural phenomena located in a specific destination based on data collected from visitors may significantly contribute to an overall picture of the place and help in the process of decision-making related to tourism development and future planning, as proposed by Štrba et al. (2017a).

Therefore, geosite assessment method based on visitors' data should be developed to contribute to not only geotourism but various natural-based tourism forms effective development. In this field, Hassan et al. (2012) can be considered as pioneers, defining a tourism demand based method of geosites assessment consisting of nine main indicators that help to identify, assign, and set the priority of assessed location. The indicators include: distance from the geosite, accessibility of the geosite, climate conditions, types of rock formation, geological history,

topography, safety, geological and geomorphological forms, and tourist's infrastructure. However, as the survey performed within the study of Hassan et al. (2012) includes 92 samples (20 professors and 72 students) is has very global low representativeness. Moreover, as this method is based on prioritization, it cannot be used to assess individual location/place. So, deep research in this field is strongly required. Additionally, based on research results of Štrba (2018), it is clear that potential geosite visitors would prefer geosite assessment based on visitors' data when available.

Conclusion

Geosites, as a part of the natural heritage, represent inseparable part of any tourist destination significantly contributing to the overall attractiveness of specific area in any part of the world. Knowledge of its value, the final score of geosite assessment, may help in the process of various nature-based tourism forms development in which geosites are included. However, recent geosite assessment methods focus primarily on the scientific character of the geosite and not on its tourist potential. To answer the question given in the title of this paper – yes, to assess. The assessment itself is a very useful tool. However, general public criteria affecting geosite visits differ from criteria used within most of the methods (Štrba 2018). Therefore, without the knowledge of relevant visitor data incorporated within the assessment, as discussed in this paper, such values, representing the result of the geosite assessment process, cannot be effectively utilized to help future geosite development and management activities.

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Souhrn
V posledních desetiletích představili různí autoři metody hodnocení nebo hodnocení geositu. Obecně lze je rozdělit na dvě hlavní skupiny: (1) modely kvalitativního hodnocení a (2) kvantitativní modely hodnocení. Hodnocení geositu ve většině případů jsou silně vědecky založené. Aplikace výsledků hodnocení ve vývoji

produktů cestovního ruchu je tedy velmi omezená nebo absolutně nemožná. Obecně lze předpokládat, že v rámci téměř každé metody kvantitativního hodnocení existují některé kategorie hodnocení nebo kritéria, mezi které patří: bezpečnostní rarita, zástupci, integrita, přístupnost, ekologická hodnota a ekonomická hodnota. Kvalitativní metody hodnocení geositu vedou k individuálnímu skóre nebo souboru čísel / bodů. Ale co říká číslo? Jakákoli forma cestovního ruchu je silně závislá na návštěvnících a jejich zájmů o zážitek z cestovního ruchu založený na přírodě. Existuje však velmi nedostatečný počet publikací, které představují výsledky výzkumu zaměřené na geoturistiku nebo jiné formy cestovního ruchu založené na přírodě. Nedávno nejúčinnějším nástrojem pro shromažďování, třídění, analýzu a využívání údajů návštěvníků pro rozhodování, budoucí plánování a řízení v cestovním ruchu představují inteligentní cílové systémy nebo platformy. Chcete-li odpovědět na otázku uvedenou v názvu tohoto příspěvku - ano, posoudit. Samotné hodnocení je velmi užitečným nástrojem. Obecná kritéria týkající se geositu se však liší od kritérií používaných ve většině metod. Bez znalosti příslušných údajů o návštěvnosti začleněných do posouzení, jak je uvedeno v tomto dokumentu, nemohou být tyto hodnoty, které představují výsledek procesu posuzování geositu, efektivně využity pro budoucí vývoj a správu geositu.

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TOURIST INTEREST IN ILLICIT ZONE OF ICE CAVES

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Abstract
Ledové sluje (Ice Caves) in the Podyjí National Park represents one of the most spectacular sites within the area. It consists of the large boulder field and several pseudokarst caverns on the north-western slope of the ridge that are very important from the ecological and geomorphological point of view. The access to the site is restricted for the visitors of National Park as there exists a risk of damage and disturbance of these unique phenomena; tourist can use the marked paths leading around the site, they can reach the top part of the ridge.
Currently, there are only several persons who have legal access to the site (employees of the National Park Administration and other researches with the permission issued by NP Administration). However, the installed sensor that counts the passages proved that the site is visited more frequently than it should be. The number of people who visit this site (situated within the first zone of National Park where there is no marked path and so the access is forbidden by decree) is quite alarming. Based on these findings, some proposals for the solution of this unfavourable situation are proposed and other possibilities how to avoid this undesirable phenomenon are discussed.

Key words: Podyji National Park, restricted area, passages monitoring

Introduction: history of the tourism on the Ledové sluje (Ice Caves)

The Ice Caves were visited already in the 18th century and probably earlier by locals (Skutil 1950). Under the influence of Romanticism and in order to make the mysterious surroundings of the caves accessible, the owner of the Vranov County, Princess Helena Mnizsková (née Lubomirská) let built a path across the slope from the Dyje river to the ridge in 1858 – 1859. In 1860, an obelisque on the top of the ridge was built by Vranov Beautification Society to honor the Princess.
The Obelisque and the passage trail increased the popularity of the Ice Caves, so at the end of the 19th century, the Znojmo section of the Austrian Tourist Club marked one of the first hiking trails. This red marked path from Čížov to Vranov through Ice Caves describes Zobal (1927) in the historical tourist guide Podyjí.
The hundred year old tourist tradition was interrupted by the integration of the site and its surrounding into the border zone and the inaccessible zone of the Iron Curtain in the years 1960 - 1990. After the establishment and declaration of the Podyjí Protected Landscape Area and subsequently the Podyjí National Park (in 1991), there was no restoration of the tourist route in order to protect the unique natural phenomena and also regarding visitor safety due to increased risk of rock fall and boulder movements. In addition, the natural processes have gradually limited the viability of the original trail due to loosening the stone blocks or blocking by fallen trees. At present, it is possible to visit the Ice Caves very rarely (once per several years) on the occasion of popularizing excursions for the public under the auspices of the Administration of the Podyjí NP. However, the non-intervention and inaccessible mode of the site is very often violated.

Study area and its assessment

For the description and assessment of the Ice Caves, we come out from the geomorphosite concept which define geomorphosites as „landforms that have acquired a scientific, cultural/historical, aesthetic and/or social/economic value due to human perception or exploitation“ (Panizza 2001). Within this concept, numerous assessment methods were introduced and used for various purposes, especially for geoconservation, geoheritage management and geotourism (e.g. Coratza and Giusti 2005, Cendrero and Bruschi 2005, Reynard et al. 2007, Zouros 2007, Pereira and Pereira 2010, Fassoulas et al. 2012, Kubalíková and Kirchner 2016) and critically reviewed (e.g. Kubalíková 2013, Brilha 2016 or Reynard et al. 2016). Generally, these methods are based on the detailed examination and description of the site and they include several groups of values, e.g. scientific, added or conservation values. For the purposes of this case study, we propose to use an integrated method which comes out from the aforementioned methods and which consists of a set of questions. The assessment is qualitative, because in the case of unique site, the numerical assessment is irelevant. The assessment of the site is presented in Table 1.

Tab. 1: Assessment of the Ice Caves

Values	**criteria (in bold)** / question	answers
Scientific values	**Integrity or current status of the site:** Is the site (including particular Earth-science features) well conserved or is it damaged?	The site - including particular Earth-science features is well preserved especially thank to its today‘s position in the first zone of National Park and its position within the inaccessible area (proximity to the Iron curtain) in the past.
	Diversity of the Earth-science features: How many Earth-science features is displayed within the site? (specific landforms – macro, mezo and microforms, stratotypes, lithological boundaries, fossils, minerals, soil profiles, current processes etc.)	Landforms: pseudokarst caves, block and debris accumulations, frost cliffs, crevasses Processes: weathering, slow movements of the boulders within block accumulations, rock fall, the formation of debris heaps, opening the crevasses
	Rarity: How many similar sites lies within a study area? Is the site unique or is it current within the area?	The pseudokarst caves are unique, however, in the Podyjí National Park, there are a lot of similar block accumulations and frost cliffs.
	Scientific knowledge of the site: Is the site known within scientific community? Are there some papers, monographies etc.?	The site is widely known within scientific community, it has been explored since 19th century, numerous scientific papers were elaborated (e.g. Roth 1863, Jarz 1884, Koláček 1922, Špalek 1935, Skutil 1950, Gruna and Reiter eds. 1996, Pospíšil and Pazdírek 1998, Wagner 2001, Košťák 2001, Demek 2007, Kuda 2016).
	Exemplarity and representativeness of the site: Are the features (both landforms and processes) visible and comprehensible? Is there a possibility of simple explication of the corresponding processes?	The site is an excelent example of pseudokarst caves, frost cliffs and block accumulations in crystalinic rocks, the processes cannot be observable by eye, but the traces of the processes are visible (opening the crevasses, rock fall), so there is a possibility to explain the processes to the laic public. There are no educational facilities on the site, only the mention about it on the panel on the top of the ridge near obelisque.
	Palaeogeographic importance: Is the site significant for the understanding of the geomorphological evolution of the area?	The site‘s palaeogeographic importance is very high as it allows to reconstruct the evolution of the Dyje Valley and surrounding area. Nevertheless, the origin of the site has not been satisfactorily explained yet and there are numerous hypothesis

		about it.
Tourist value	**Accessibility:** Is the site accessible or is the access limited/restricted?	The access is restricted due to the site's great scientific value. It is situated within the first zone of NP and there is no marked path leading there (however, in the past, there was, and today, some tourists do not respect the rules and laws and they visit the site).
	Safety: Are there any phenomena that can endanger visitor?	The site is not safe due to the movement of boulders on the block accumulations, the visit of the pseudokarst caves requires specific equipment and experience.
	Tourist infrastructure: Are there some tourist facilities nearby? (transport – parking place, catering, shelters, marked paths)	A marked path leads nearby, the access of cars is restricted, in Vranov or Lesná (cca 4 km), a complete tourist infrastructure can be found.
Added value	**Ecological aspect:** Are there some particular species/ecosystems?	*Cimicifuga europaea* (critically threatened plant) *Discus ruderatus* (mollusque; relic from the last glacial) *Microchiroptera* (bats) – 19 out of a total of 26 species living in the Czech Republic were observed, it is considered one of the largest gathering place. *Araneae* (spiders) – 21 relic species Specific case of vegetative reproduction of spruce (*Picea abies*) Generally, the biodiversity (resp. species diversity) is very high thanks to the diversity of the geo(morpho)logical conditions and specific microclimatic conditions: 159 species of lichens, 133 species of moss, 28 species of liverworts, 502 species of vascular plants, 58 species of spiders and 39 species of mammals.
	Cultural aspect: How many different cultural aspects can be recognized? (e.g. historical aspect – historical importance, historical object related to the site; archeological aspect – archaeological findings; artistic aspect – site as an inspiration for artists; geomythological aspect – myths about the site; other aspects)	Historical importance: traditional and favourite tourist destination of the area, old stone path, obelisque on the top of the ridge (raised in the 19th century), important landmark Artistic aspect: the site is displayed on several drawings of J. Doré (19th century) Geomythological aspect: several legends about the caves and obelisque.
Conservation value	**Existing legislative protection:** Is the site legally protected? (declared as monument, reservation)	The site is situated in the first zone of National Park, the management is based on the Care Plan.
	Current threats: Are there any threats that can contribute to the damage of the site? (both natural (e.g. vegetation growth, invasion species, landslides) and anthropogenic (e.g. vandalism, inapropriate conduct of tourists, pollution))	Natural threats: practically, there are no natural threats that could endanger the site or decrease its value (especially the diversity of landforms and processes) Anthropogenic threats: tourists that illegally visit the site – the specific microclimate can be modified, the intensity of some natural processes can be increased (movements of the boulders), the specific ecosystem can be endangered.

To conclude the most important points of the assessment, the SWOT analysis is done (see Table 2).

Tab. 2: The SWOT analysis of the Ice Caves

Strenghts:	Weaknesses:
- high diversity of the landforms and processes, the uniqueness of some of them - strong scientific interest on the site, high degree of exploration, continuing monitoring of the site - high ecological value of the site - the highest level of legal protection – the position of the site in the first zone of NP	- fragility of ecosystems, microclimate and landforms - disturbing of the site by tourists
Opportunities:	Threats:
- the continuous exploration can bring the answer to the question of origin of this unique site and surrounding area - high potential for environmental education (ecology, biology, geology, geomorphology) – the question is if it should be used and for whom (laic public? students?)	- continuing disturbances caused by tourists - the lack of finances on further monitoring and research

Methods and results

For the counting of the visits on the Ice Caves, the data scanned by pyroelectric sensor which does not take into accoutn the disrection of the movement, was used. The data were statistically processed and evaluated in the MS Excel.

Overall statistics shows the collected year-round monitoring data (March 2017 to February 2018). Average daily attendance is 2.04 people per day (1.22 on working days and 3.84 on non-working days), see Figure 1.

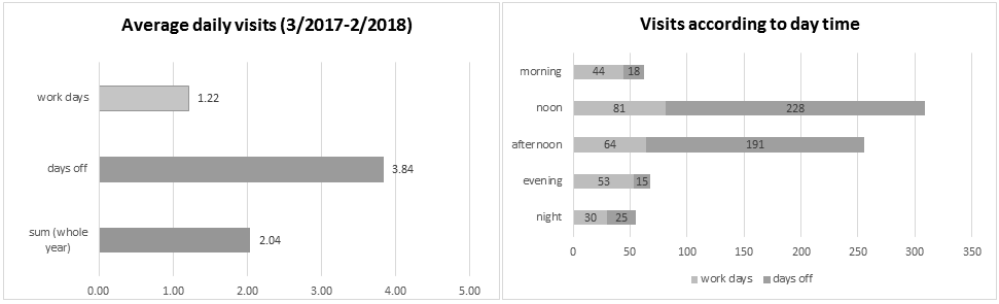

Fig. 1: Average daily attendance on Ice Caves (3/2017 – 2/2018) & Figure 2: The number of passages regarding to the day time

Concerning the passages regarding to the day time, in the non-working days (weekends and public holidays), the passages around noon and afternoon prevail (between 10 am and 5 pm). During week days (working days), the visits are spread evenly throughout the day, the highest intensity is around noon, followed by afternoon and evening passages, see Figure 2.

The maximum absolute number of passes was recorded in May 2017, also after the conversion on relative passages per day, May remained the most visited month with 4 passes per day, see Figure 3.

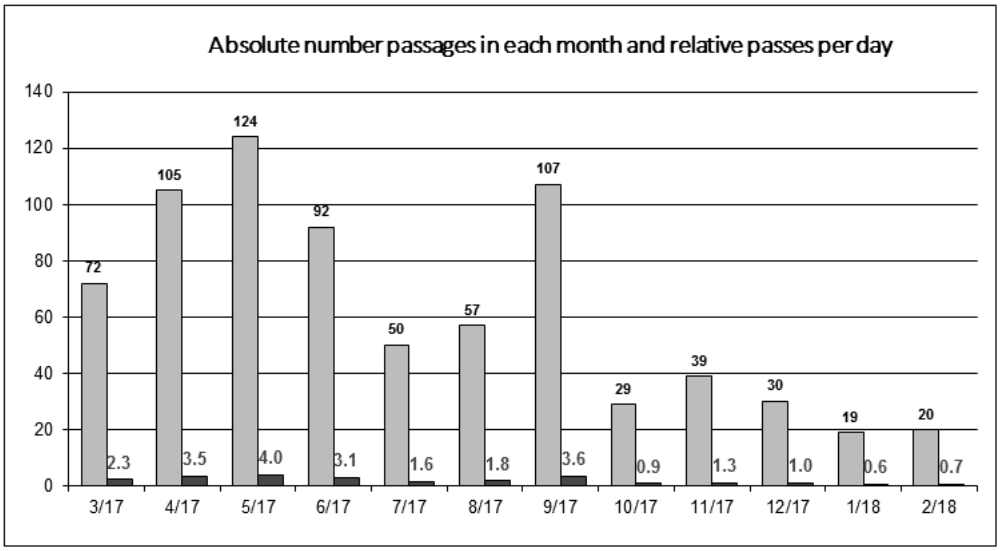

Fig. 2: The passages in particular months

Discussion and conclusions

Based on the assessment, SWOT analysis and data/statistics of the visits, some proposals for the future use of the site can be presented:

- leave the site unaccessible because of its uniqueness, inner diversity and fragility and the possible risks
- increase the number of controls of nature guardians on the site, especially on the weekends and holidays during the most exposed times of passages (according to the results of the monitoring)
- in case of lack of the nature guardians, discuss the possibility of recruitment of voluntary nature guardians
- discuss the possible use of the site for education (organized tours for small groups, environmental education for students), use of the digitalised model of the pseudokarst caves for the illustration, however, it can attract people‘s attention to the site and illegal visits can continue
- inform the public about the gravitational movements on the block accumulation in general and consequently, about the risks and dangers of the non-controlled movement of the tourists on the block accumulations
- discuss the possibility of opening new marked trails leading to similar block accumulations or frost cliffs (as an alternative to the tempting Ice Caves), e.g. on the opposite slope (Braitava) – to use already existing paths and ways – from the foot bridge at Zadní hamry over Braitava and Braitavský letohrádek back to the Dyje Valley
- continuous further research of the site

These points are just in the state of proposals, so the further discussion, detailed analysis and research is needed. Based on that, the management of this unique site can be efficient and succesfull.

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Souhrn
Využití nástrojů SWOT analýzy a monitorování počtu nelegálních návštěvníků přináší cenné informace pro management ochrany přírody. V případě Správy NP Podyjí bude hodnocení využito pro přípravu popularizačních materiálů s cílem zvýšit povědomí o jedinečnosti a křehkosti lokality Ledové sluje. Podle výsledků sčítání vstupů do zakázané zóny bude upraven režimu kontrol prováděných strážci přírody. Po dlouhodobějším monitorování pak bude možné odpovědět na otázku, zda se zveřejňování informací o slujích projevu negativně ve zvýšené návštěvnosti, nebo pozitivně poklesem vstupů díky rozšíření povědomí o riziku poškození lokality a nebezpečí vlastního úrazu.

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UNIQUE NATURAL MOUNTAIN LAKES IN TATRA NATIONAL PARK – TOURISM AND NATURE PROTECTION HAND IN HAND?

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Abstract
Tatras are the most visited protected area in the Slovak Republic. There are many natural interests in the region of the Tatras. Among the most valuable and most interesting of them include 113 unique natural mountain lakes (ponds) which have a glacial origin. Mountain natural lakes belong to the most beatiful natural formations in Tatra National Park. Many of them are often destination of walks and mountain hikes for a large number of domestic and foreign visitors. Mountain natural lakes in Tatra National Park belong to the highest – fifth degree of landscape protection in Slovakia. For this reason, it is essential to insure their protection very sensitively and responsibly. The article discusses interesting facts about the most important lakes and at the same time deals with some protection possibilities of these unique and valuable natural formations.

Key words: glacial ponds, hiking trails, Slovakia

Introduction

Tatras are the most visited protected area in Slovakia. The Tatras have been from January 1, 1949 declared as Tatra National Park with an area of 738 km^2; the buffer zone around the park covers an area of 307 km^2; it is 1045 km^2 together. Together with the Polish part of the Tatras was on this area estabilished in 1993 the UNESCO Biosphere Reserve. There are many natural interests in the Tatras. Among the most valuable and most interesting of them include 113 unique natural mountain lakes (ponds). Mountain lakes belong to the most beatiful natural formations in Tatra National Park. Many of them are often destination of walks and mountain hikes for a large number of domestic and foreign visitors.

Tatra National Park is the oldest national park on the territory of Slovakia. In the Tatra National Park is located about 600 km of marked hiking trails and about 16 marked and maintained bike trails. In the High Tatras is located more than 30 km of hiking trails for disabled people in wheelchair, too (Jakubisová 2016, 2018, Janeczko et al. 2016). The number of mountain actvities pursued by tourists have increased dramatically in recent years. The number of visitors in the Tatra region is increasing dangerously. In recent years it can be more than 5.000,000 visitors per year. Often sough after and frequented sites in the Tatras are Tatra mountain natural lakes. Some lakes are very easily accessible (for example Štrbské pleso, Fig. 1, Fig. 2) which is often used for various commercial (ever very questionable) activities. Some lakes are directly on hiking trails (for example Popradské pleso, Batizovské pleso, Velické pleso etc.) so their attendance is high and therefore is their protection demanding. Some lakes are not accessibly by hiking trails (for example (Ľadové pleso, České pleso, Zmrzlé pleso etc.).

Fig. 1: Štrbské pleso (1347 m a. s. l.) is the most visited lake in the High Tatras (Photo: M. Jakubisová)

Main issues

The development of the Tatra Mountains alpine landscape after the extincion of the valley glaciers took place through several stages, which left significant traces in their relief. In addition to the basic features of the relief of the Tatras valleys, a significant element of glaciers activity are also water-filled basins - natural lakes. Their genesis is associated with the retreat of glaciers in their final stages of development, it means 8-10 thousand years ago. Today's meaning of

Fig. 2: Štrbské pleso (1347 m a. s. l.) with buildings directly on the lake shore (Photo: M. Jakubisová)

the natural lakes is irreplaceable (http://www.nocvyskumnikov.sk/novinky/2017/veda-v-centre-tatranske-plesa-hrozi-im-postupny-zanik.html). Tatra lakes have a specific term in Slovak: „pleso“ (lake) or „plesá“ (lakes). There are 113 of natural lakes in the Tatras. Of this number, there are 92 lakes in the Eastern Tatras and 21 in the Western Tatras (Fig. 3, Fig. 4). The importance of Tatra lakes is multifarious:

- serve as natural resources and reservoirs of water,
- contribute to the optimization of discharges in watercourses (torrents),
- are important for flood and erosion control in the landscape,
- are important in terms of assessing the historical development of the landscape,
- are a part of ecosystems with specific flora and fauna,
- have an irreplaceable landscape-aesthetic effect,
- have cultural, scientific and educational significance,
- serve as an indicator of climate change.

Total area of natural lakes in the Tatras is 1 697 342 m^2, i. e. 169.7342 hectares and 1. 697 342 km^2. The total volume of natural lakes in the Tatras is 12 755 037 m^3 (processed by Pacl, Gregor 2010). The survey of the largest natural lakes in the Tatras by level altitude L (m a.s.l.), volume V (m^3), area A (m^2) and maximal depth H_{max} (m) is in Table 1.

Tab. 1: Tatra natural lakes (ponds) by level altitude, volume, area and maximal depth (Pacl, Gregor 2010)

Level altitude L (m a. s. l.)		**Volume V (m^3)**	
Modré	2189	Veľké Hincovo	4 091 712
Vyšné Wahlenbergovo	2157	Nižné Temnosmrečinské	1 501 500
Horné Velické plieska I	2141	Štrbské	1 299 400
Vyšné Rumanovo	2128	Nižné Terianske	871 668
Vyšné Terianske	2124	Vyšné Bielovodské Žabie	839 413
Area A (m^2)		**Maximal depth H_{max} (m)**	
Veľké Hincovo	200 800	Veľké Hincovo	54
Štrbské	196 700	Nižné Terianske	47.3
Nižné Temnosmrečinské	117 045	Nižné Temnosmrečinské	38.1
Vyšné Bielovodské Žabie	94 640	Zelené Krivánske	29.5
Popradské	68 695	Vyšné Bielovodské Žabie	24.8

One of the important problems of Tatra lakes is their sedimentation by sediments from surroundings slopes. From these reasons, they are at risk of gradual extincion of Tatra lakes (Hreško et al. 2013).

Fig. 3: Račkove plesá (1697 m a. s. l.) in Račková valley in the Western Tatras (Photo: M. Jakubis)

Important questions in connection with Tatra lakes protection

We have in mind in this context a few basic questions:

• If should be Tatra lakes for people, is every visitor capable to understand the limits of their bearing capacity and vulnerability?

• How best to provide this information to visitors?

• If should be Tatra lakes only the natural protected treasures, what must their protection be?
• Should be the conditions of protection the same for all of Tatra lakes?
• Are in this case possible compromises by the idea: public recreation and Tatra lakes protection – with nature hand in hand?
• Is the economic effect more important than lakes protection?
We need to look for the right answers to these questions very responsibly.

Fig. 4: Račkove plesá (1697 m a. s. l.) in the Western Tatras with peak Klin (2172.7 m a. s. l.) from peak Jakubiná (2193.7 m a. s. l.) (Photo: M. Jakubis)

Possible options of solutions
• More frequent checks by the nature conservation authorities;
• Stricter fines for violation of the Tatra National Park Tourist Regulations;
• Better visitor awareness about the lakes protection (without the constructions of information boards near the lakes);
• Prohibition of any interference to the natural state of lakes;
• Total ban of construction on the shores of the lakes;
• Ban of commercial activities in the lakes;
• Expanding the intereest of scientific research focusing on the Tatra natural lakes.

Conclusion
Natural glacial lakes are one of the most valuable parts of the Tatras nature. On the one hand, their strict protection is inviolable, on the other hand it is necessary to allow visitors to admire them. One of the ways to find compromises to address these issues is to raise the knowledgeability of visitors about the protection so as to prevent any disturbance of these valuable and irreplaceable components of Tatra nature. There are many published articles about Tatras natural lakes. Their rarity, uniqueness, great attractiveness, and their vulnerability, however, convince us that in the future they will be the subject of interest to the general public, visitors and scientists from various areas of research. For these reasons, we think that every article that highlights this issue can be beneficial for the protection of Tatra Lakes.

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Souhrn
Tatry jsou nejnavštěvovanějším chráněným územím na Slovensku. Toto území bylo od 1. ledna 1949 vyhlášeno za Tatranský národní park s rozlohou 738 km^2 a nárazníkovým pásmem s rozlohou 307 km^2; to je dohromady 1045 km^2. Spolu s

polskou částí Vysokých Tater byla v této oblasti zřízena v roce 1993 biosférická rezervace UNESCO. V Tatrách je velmi mnoho přírodních zajímavostí. Mezi nejcennější a nejzajímavější patří 113 jedinečných přírodních horských jezer s místním názvem plesa. Z tohoto počtu je 92 jezer ve Východních Tatrách a 21 jezer v Západních Tatrách. Celková plocha přírodních jezer v Tatrách je 1 697 342 m^2, tj. 169,7342 hektarů resp. 1, 697 342 km^2. Celkový objem přírodních jezer v Tatrách činí 12 755 037 m^3. Význam tatranských přírodních jezer je různorodý: slouží jako přírodní zdroje a nádrže s vodou, přispívají k optimalizaci vodnosti vodních toků (bystřin), jsou důležité pro ochranu před povodněmi a erozí v krajině, jsou součástí ekosystémů se specifickou flórou a faunou, mají nenahraditelný krajinný a estetický efekt, slouží jako ukazatel změn klimatu. Horské přírodní jezera patří k nejkrásnějším přírodním útvarům v Tatranském národním parku. Mnoho z nich je často vyhledáváno velkým počtem domácích i zahraničních návštěvníků na procházky a pro horské túry. Horské jezera v Tatranském národním parku patří do nejvyššího - pátého stupně ochrany krajiny. Z tohoto důvodu je nezbytné zajistit jejich ochranu velmi citlivě a zodpovědně. Článek se zabývá některými fakty o nejvýznamnějších jezerech a zároveň některými otázkami v souvislosti s možnostmi ochrany těchto jedinečných a hodnotných přírodních útvarů.

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UNUSUAL TYPES (LITTLE USED) OF SHORE STABILIZATION

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Abstract
The basis for the stabilization process is technical ways of bank stabilization, stabilization methods of biological engineering and biotechnical ways of stabilization. Less often they are used in our country breakwaters.
Another group is longitudinal redirecting constructions (built along the banks) and transversal redirecting constructions (built perpendicular or slanting to the bank).

Key words: Reservoir, construction, slope, water, bank

Introduction

We are also using reinforced ground construction - anti-erosion mat ENKAMAT – the most suitable for the purposes of bank stabilization with cooperation of root systems. Other great advantages are its good availability in the Czech market, its variability, selection from several versions – a broad range. We futher explored also geosynthetics by the Polyfet company (Schoklitsch, 1930; Zeleňáková et al, 2015).
It is also possible to use geocells – suitable for stabilization of roads and high embankments – fig.1.

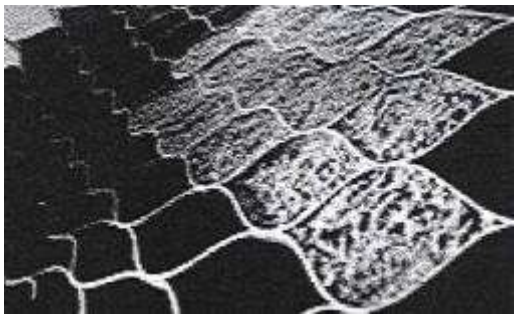

Fig. 1: Geocells – suitable for stabilization of roads and high embankments (Šlezingr, 2011)

Materials and methods

One of the unconventional possibilities is active erosion prevention constructions. It is :

1. Longitudinal redirecting constructions (built along the banks) (Jedlička, Šlezingr, 2010; Kotásková et al, 2016)
   a longitudinal bar
   a longitudinal interrupted bar
2. Transversal redirecting constructions (built perpendicular or slanting to the bank)
   spur dikes perpendicular to the bank
   spur dikes slanting to the bank

3. Combined redirecting constructions
   - consist of interrupted longitudinal constructions and perpendicular transversal constructions that connect the former with the bank (Pelikán et al, 2018; Schoklitsch, 1930)
4. Submerged breakwaters
   permeable breakwaters
   impermeable breakwaters

Examples

Longitudinal redirecting constructions – little fence of branches, multi-row (fig 2,3).

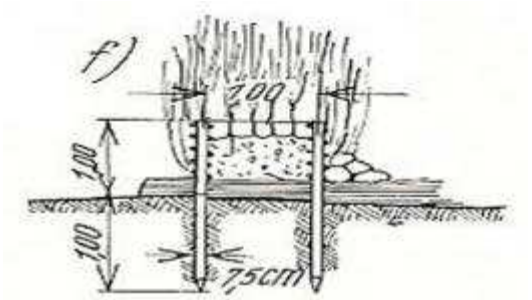

Fig. 2: Little fence of branches, double-row, Schoklitsch, 1930 - pen drawing (Zeleňáková et al, 2015)

Fig. 3: Implementation on research plot (Brno reservoir 2015) (Šlezingr, 2011)

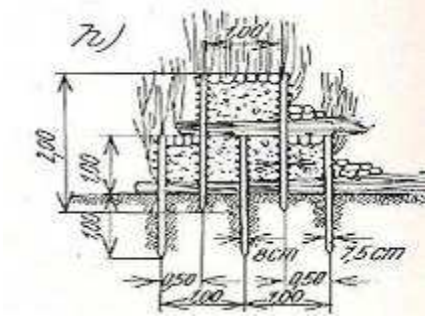

Fig. 4: Little fence of branches,multi-row three-row Schoklitsch,1930-pen drawing

Fig. 5: Implementation on research plot - three-row (Brno reservoir 2016)

Results

The above are examples of bank fortifications - longitudinal redirecting constructions (little fence of branches, multi-row) they work very well. Clay behind the breakwater remains. It is not carry away into the resarvoir. This is the purpose of this construction.

We will continue on tracking in next years.

Conclusion

This active stabilization is also suitable for 1st degree of erosion (an extensive damage to banks by the most intensive erosion; the sections most exposed to waves; the slopes are steep or even vertical, resistance to damage is minimal;

erosion walls are over 3 m high and 2ND degree of erosion steep, almost vertical erosion walls, 1–3 m high; the vegetation cover is inefficient regarding erosion prevention (as in the previous case).

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Souhrn
Základem protierozní a protiabrazní ochrany svahů tvořících břeh vodního toku či nádrže je jejich řádná ochrana, realizovaná již před uvedením vodního díla do provozu (v případě potenciálního abrazního poškození se jedná o dobudování přehradní zdi či hráze, u vodního toku pak dokončení jeho úpravy). Následná ochrana, kdy se již projeví na nechráněném břehu poškození je mnohem složitější a nákladnější. Jednou z možností je aktivní ochrana pomocí předsazených vlnolamů. Toto je i motivem prezentovaného článku. Popsány jsou realizace těchto ochranných prvků na nádrži Brno. Zkušenosti z provozu a výsledky budou aplikovány na nádrži Hulín (zatopená pískovna) i jinde.

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USING GIS TO PREDICT POTENTIAL ENVIRONMENTAL CONFLICTS IN THE COLCA AND ANDAGUA VOLCANOES GEOPARK (PERU)

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Abstract
The Colca Canyon in the southern Peru, listed in the Guinness Book of World Records as the deepest canyon in the world, is a place of unique landscapes and scientific values. Along with the Valley of Volcanoes is on the list of candidates for the UNESCO Global Geoparks Network. The dynamic economic and tourism development of the Rio Colca region and the unrestricted development of the infrastructure poses a threat to this area. There is a continuous increase of the number of tourists visiting the Colca Canyon every year. In 2016, the Canyon was visited by about 250,000 people. The analysis identified three of the region's most thriving economic development areas: tourism, agriculture and mining, where spatial variations were analysed, potential conflicts and actions were identified to address the regions's sustainable development. It is important to define the principles of coexistence in the same area of different entities. Conflicts are caused by the excessive local development of tourism, communication or mining infrastructure. There is a rapid change because investors want to stay ahead of the restrictions related to environmental protection.

Key words: geopark, environmental conflicts, GIS, Colca Canyon, Peru

Introduction

The development of tourism in the Colca Canyon causes a growing problem in maintaining unchanged valuable environmental resources, including geological diversity. Investors' activity in this branch of the economy is carried out without taking into account the environmental conditions and leads to a loss of fundamental values, thereby decreasing or even stronger reducing the attractiveness of the tourism. Establishing a Geopark as a form of protection consist in including in these activities the cooperation and consent of local communities. The educational aspect is of particular importance in this case, the information and educational activities of the local community and tourists are carried out. Due to the abundance of the natural surroundings of the Colca Canyon and indirectly usable nature of the area there is the possibility of occur sources of conflict (Gałaś, 2008).

The Board of the proposed Geopark is seeking for its membership in the global network of Geoparks of UNESCO. Geoparks belonging to this network can count on strong support from the UNESCO when it comes to promoting in the world. However, the admission criteria of the network are often difficult challenge. In addition to ensuring the protection of geodiversity in the Geopark area, economic development must meet the requirements of sustainable development. Great importance is given to the educational role of geoparks in the context of raising environmental awareness of visitors. Especially in the sphere of life, surrounded by natural resources, but without generating conflicts in their use (Zavala, Churata, 2016).

Material and methods

Spatial analysis of the area was carried out within the boundaries of the planned Colca and Wulkana Andagua Geopark in Peru using the ArcGIS program based on data obtained as a result of research conducted by the Polish Science Expedition to Peru and the Peruvian sources. In the analysis was taken into account the proposed geo-stations, resources of mineral deposits and areas of exploration concessions for precious metals designated in the course of research, information about the existing and planned road network, large tourist centers and living natural resources. Mining, regional hydrotechnical investments, development of communication infrastructure and transmission of electricity as well as development of the tourism industry (mainly construction of large hotels and SPA centers) have a serious impact on the environment of the discussed area. Natural areas protected or postulated for protection were considered as the most sensitive. Three classes of functional and spatial conflicts were determined. It was considered that for the sustainable development of the designed geopark, overlapping of two forms of use is not very conflictual (I class), three - medium conflict (II class) and more than three - very conflictual, protective measures required (III class).

Results

As a result of the creation of a Geopark in mining, post-mining and adjacent areas, it is necessary to conduct monitoring of the state of the environment. This is due to the fact that dumps of post-mining and processing waste may contain toxic metals. As was previously indicated, inadequately protected storage site can be a source of contamination of the local rivers. It can therefore be concluded that there is a small conflict between the development of mining and the protection of natural assets of the environment. However, post-mining areas should be monitored and protected in order to avoid possible contamination of waters.

Due to the local climatic conditions and the difficult area, agricultural activity is only carried out on the northern slopes of the canyon. Small villages located on the northern slopes do not threaten the functioning of the Geopark or adversely affect the natural environment. A large part of the slopes has been anthropogenically changed to terraces intended for agricultural purposes. Agricultural use causes a little conflict with other environmental resources. In the future, this may change due to the ever-easier access to fertilizers and plant protection products. The Rio Colca basin can be very sensitive to the flow of fertilizers. The problem requires control and education, because it can easily turn into a very big conflict. The launch of the Majes-Siguas irrigation system resulted in a decrease in water flow at Colca and control resources located in the upper part of the drainage area. Consequently, the level of water in the Rio Colca makes it impossible to flow and rafting, which significantly affect the tourist development in the Canyon. It is obvious that such a significant change in the flow of the waters will have an impact on surrounding ecosystems, this may lead to a reduction in biodiversity, which is one of the decisive factors when establishing protected areas. On the site of the future geopark, the construction of hydroelectric plants using significant drops of mountain rivers may be a serious problem. In principle, the design work was completed in two locations: on the Molloco River and in the Mamacocha Lagoon. In the Molloco Valley, which joins the Colca Canyon, construction of the dam and accompanying facilities will negatively affect the landscape, it will also deprive the waterfall of water, which is a well-known tourist attraction.

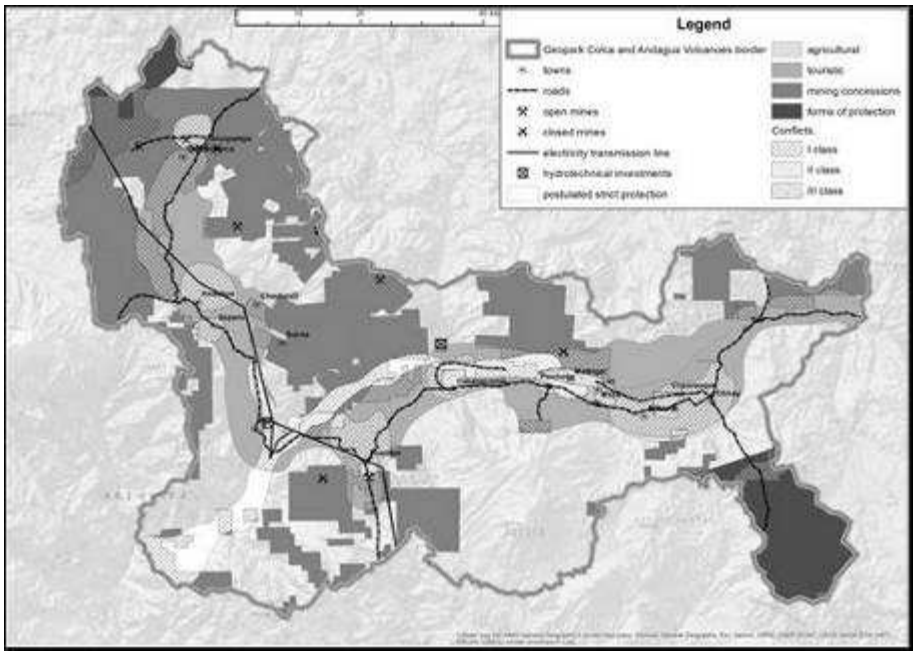

Fig. 1: Map of functional and spatial conflicts in the Geopark Colca and Andagua Volcanoes

Hydrotechnical constructions generate a very large conflict within Geopark, but this is largely due to the existence of objects already completed. New investments will strengthen this conflict. Locally, for example, due to the unique qualities of bio- and geodiversity of the Mamacocha Lagoon, it can mean the highest III class of conflict. Refuge wildlife, which is the lake and the river Mamacocha requires protection.

The development of the road network takes place in response to the year by year increasing number of tourists from developed countries, who expect full catering and hotel facilities as well as adequate infrastructure. The activities of investors in this industry are often implemented without taking into account the values and conditions of the local environment and lead to the loss of the unique values of this area, i.e. bio- and geodiversity, and consequently to the reduction or even loss of tourist attractions of the area (Figure 1). The most important investment is the road connection realized from the Valley of Volcanoes through Colca Canyon to Huambo. The extremely complex geological structure highlighted by active faults in the Holocene, active scree, steep rock walls exposed to outcrops pose a serious challenge from the point of view of engineering geology. In this place, the construction of three bridge connections based on the extremely steep, tectonically involved surface is planned. From the point of view of the communication network and economic development, the road will be of paramount importance. It is difficult to predict the effects of opening this road connection for the ethnographic values and traditions. The experience of previous investments (Majes Siguas project, Transmontaro high voltage transmission line) indicates that significant impoverishment can be expected. There is a serious risk that the maintenance of the road will require a major effort and additional work on the steep Screes and the Colca Canyon. From the point of view of the conflict with natural and cultural resources, road construction is a very big conflict (III class) (Gałaś et al., 2016).

The main direction of economic development of the Colca Canyon and the Volcano Valley is tourism. However, its excessive development can negatively affect the environment and degrade valuable areas. Within the Geopark, over 100 geosites indicating the most valuable objects and areas of the natural environment have been designated. They were marked with an array with a number and new paths were created for some. A novelty is the organization of accommodation on the principles of agritourism. Increase the exposure of valuable qualities, accommodation and the development of the road network is not in any way coordinated with the authorities of the project. Cabanaconde is an example of a chaotic competition for tourists, which in a short time abandoned the construction of adobe, stone and straw in favour of concrete, angular hotels and shops. The number of hotels along the Colca river is constantly increasing, often at the expense of access to its picturesque shores.
The plans also include the creation of educational and thematic paths, whose task is not only to show the unique qualities of the environment, but also to raise the awareness of the local community and tourists about the need to protect these extremely valuable elements of the environment. The strong construction pressure of the hotel industry will soon prevent the creation of routes combining individual values. In the last 10 years, paths connecting both banks of the Canyon are replaced by unpaved roads. The big conflict of the tourism industry can be reduced if its investments will be preceded by studies from the scope of the impact on the environment.

Discussion and conclusion

On the basis of spatial analysis, the conditions and limitations of access to geological areas in relation to environmental protection were assessed. It was necessary to determine the limits of the possibility of using various environmental resources. In addition to the tourism industry in the region, other areas such as mining and agriculture as well as hydro-technical and energy projects on a trans-regional scale is rapidly thriving. A very important issue is to determine the rules for the co-existence of various economic entities within the created Geopark. Often the areas of the mining industry coincide with tourist values and agricultural crops. Such situations were interpreted as the potential conflict of the use of environmental resources. Objects already completed or in the course of implementation of a nature other than tourism and recreation (Transmontaro, Majes-Siguas, Andagua-Huambo road) were considered as conflicting with the values of geodiversity that will be exhibited at the Geopark.
Establishing the principles of mutual development and functioning of entities from various fields of the economy operating in the same areas is one of the main tasks and challenges of the authorities of the created Geopark. Areas of potential conflict occur primarily along the Colca Canyon near the main centers of both economic and industrial as well as tourist. These are mainly the areas around Huambo, Andagua, Cabanaconde, Madrigal and Chivay (Radwanek-Bąk, 2014). As a result of the increase in the number of tourists and the creation of a network of geosites, a dynamic development of the road network is observed within the largest concentrations of geosites of the same or a different thematic group.
Geopark as a form of protection is established not only to identify and protect phenomena and processes leading to the creation of local geological forms, but above all to build awareness of the need to protect non-renewable resources of the environment. Establishing appropriate access limits, principles of economic development, coexistence of entities from various fields of economy and protection

in order to secure particularly valuable environmental values are the main tasks for research centers and state institutions. The creation of a protected area is intended to regulate all economic activities within it, and their control of the authorities of Geopark to ensure the safety of preservation of the unique natural values surroundings of the Colca Canyon (Gałaś&Gałaś, 2011).
In the last few years in the park area, it can be seen a kind of mobilisation among the investment especially in infrastructure and tourism. This is to implement a series of investments that are not neutral for the environment before the restrictions related to area protection of nature are introduced. The only chance to preserve the most precious values is to accelerate the formal establishment of the national Geopark Colca and Andaghua volcanoes.

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Souhrn

Kaňon Colca v jižním Peru, který je uveden v Guinnessově knize světových rekordů jako nejhlubší kaňon na světě, je místem jedinečné krajiny, geodiversity a vědeckých hodnot. Spolu s Údolím sopky je na seznamu kandidátů na Globální geopark síť UNESCO. Dynamický rozvoj hospodářství a cestovního ruchu regionu Rio Colca a neomezený rozvoj turistické a silniční infrastruktury představuje pro tuto oblast hrozbu. Neustále roste počet turistů navštěvujících kaňon Colca, v roce 2016 ho navštívilo asi 250 000 lidí. Analýza identifikovala tři z nejvíce prosperujících oblastí hospodářského rozvoje v regionu: cestovní ruch, zemědělství a těžbu, kde byly analyzovány prostorové rozdíly, byly identifikovány potenciální konflikty (tři stupně konfliktu) a akce zaměřené na udržitelný rozvoj regionů. Je důležité definovat principy koexistence různých sociálně-ekonomických funkcí v téže oblasti. Konflikty jsou způsobeny nadměrným místním rozvojem cestovního ruchu, komunikace nebo důlní infrastruktury.

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VEGETATION OF CHOSEN ACTIVE WASTE LANDFILL OF COMMUNAL WASTE AS A SOURCE OF POLLEN ALLERGENS IN THE LANDSCAPE

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Abstract

The plants are perceived like a positive element in landscape. However, many of this plants produce pollen, which cause allergic reaction. The goal of this work is to establish and determine the species composition of plants that are able to sustain themselves in an active landfill and determine the share of allergenic species. The field observation was contucted on active waste landfill in the cadastral area Nětčice (Zlín Region, Czech Republic). The evaluation of the vegetation was carried out using the phytosociological method. Of the total found plant species were selected those species that produce pollen that causes allergies. Of the total found plant species were selected those species that produce pollen that causes allergies. A total of 84 plant species were found. Among the plant species growing on the waste landfill and producing allergenic pollen belong: *Amaranthus retroflexus*, *Apera spica-venti*, *Arrhenatherum elatius*, *Artemisia vulgaris*, *Atriplex hortensis*, *Atriplex patula*, *Atriplex prostrata*, *Atriplex sagittata*, *Avena fatua*, *Bromus sterilis*, *Calamagrostis epigejos*, *Dactylis glomerata*, *Digitaria sanguinalis*, *Echinochloa crus-gallii Elytrigia repens*, *Chenopodium album*, *Juglans regia*, *Lolium perenne*, *Plantago lanceolata*, *Plantago major*, *Robinia pseudacacia* and *Urtica dioica.* Pollen of plants can spread to kilometer distances. This can lead to a deterioration in the quality of life of people in the area and to limit their activities in the landscape.

Key words: vegetation, waste landfill, pollen, allergens

Introduction

Allergenic pollen is produced by a number of trees, grasses and weeds that occur in the European Union. The effects of allergenic pollen may lead to an increase in allergic problems (Greiner et al., 2012). Total environmental changes also affect the production of pollen and its spread (Osborne and Eggen, 2014), therefore, there is a need for detailed and information on possible sources of allergenic pollen. Detailed information about pollen sources can help patients cope with their health problems. Asthma and allergic rhinitis significantly reduce quality of life and have a great economic impact (Bousquetetal, 2001). The goal of this work is to establish and determine the species composition of plants that are able to sustain themselves in an active landfill and determine the share of allergenic species.

Materials and methods

The work was conducted in the cadastral area Nětčice. The Area is located in a triangular space delimited by main roads connecting the villages of Zdounky, Nětčice and Troubky-Zdislavice. It is a sanitary landfill incorporated with multilayer composite bottom liner, leachate and landfill gas collection system, and a final cover system. In terms of maintenance, the landfill is classified in the S-category - other

waste, sub-category S-OO3. The area belongs in the Kojetín bioregion situated in central Moravia and occupying the geomorphological subunit of Central Moravia Floodplain. The bioregion is formed by a broad alluvial plain with regulated rivers. Biota is of azonal character and dominated by agrocoenoses, preserved floodplain forests, remainders of meadows and ponds with abundant fauna. According to Quitt (1971), the entire region lies in the warm zone T2. Weather is warm with abundant precipitation.
The field observation was conducted on active waste of landfill. The evaluation of the vegetation was carried out using the phytosociological plots. The size of phytosociological plots were 20 m^2. The coverage was estimated as a percentage. The monitoring took place in July 2017 (Summer) and in October 2017 (Autumn). Five phytosociological plots were recorded at each habitat. The scientific names of each weed species were used according to Kubát et al. (2002). Each plant species found were evaluated in terms of the production of pollen allergens. Each plant species was assigned a coefficient: 1 – Plant species without pollen production; 2 – Plant species insignificant in terms of the types of pollen allergy; 3 – Producers of weak allergenic pollen; 4 – Producers of highly allergenic pollen only in a short period of time; 5 – Producers of highly allergenic pollen over a longer period. Degree of evaluations are shown in Table 1. The percentage of coverage was multiplied by the coefficient of pollen allergen production factor for the species concerned. The statistical data processing was carried out by means of multidimensional analyses of ecological data. The choice of optimal analysis was based on the length of the gradient (*Lengths of Gradient*). The length of the gradient was determined using segmental analysis DCA (*Detrended Correspondence Analysis*). Next were used Canonical Correspondence Analysis (CCA).

Results
A total of 84 plant species were found. The average coverage of found plant species are shown in Table 1. The results of the vegetation evaluation were first processed by DCA analysis. Based on this processing was obtained the length of the gradient, and it was 3.84. Based on this calculation for further processing was selected canonical correspondence analysis (CCA). The results of the CCA analysis evaluating the influence of term of evaluation and coverage of plant species, which are the producers of allergenic pollen are significant at the significance level $\alpha = 0.001$. This is subsequently graphically expressed by the ordination diagram (see Fig. 1) According to the ordination diagram plant species can be divided into three groups.
The first group consists of species that had a significant presence in the summer term of the evaluation (*Atriplex sagittata*, *Digitaria sanguinalis*, *Lolium perenne*, *Polygonum aviculare, Roripa sylvestris, Rubus* sp.*, Tripleurospermum inodorum*). The second group consists of species that had a significant presence in the autumn term of the evaluation (*Amaranthus powelli*, *Bromus sterilis*, *Conyza canadensis, Helianthus tuberosus*, *Rumex obtusifolius*, *Sisymbrium loeselii, Urtica dioica*). The third group consists of species that had significant occurrence in terms of both evaluation. (*Amaranthus retroflexus*, *Artemisia vulgaris*, *Calamagrostis epigejos*, *Echinochloa crus-galli*, *Elytrigia repens*, *Melilotus albus*, *Setaria pumila*).

Discussion
The mapping of vegetation of species with allergenic pollen can help direct people with allergies or asthma. The mapping of this vegetation are also a suitable means of deciding on the management of vegetation. Detailed maps of the location of

plants that produce pollen are also key to the future of pollen forecasts. Maps can be associated with key weather variables such as wind direction, wind speed, precipitation, humidity and temperature, and can be associated with both phenological and dispersion models, predicting emission timing, emissions (Skjøth et al., 2012). The monitored landfill represents a habitat with a significant occurrence of allergen pollen producing species. Among the most important producers of pollen belong *Atriplex sagittata*, *Artemisia vulgaris*, *Bromus sterilis*, *Echinochloa crus-galli*, *Amaranthus retroflexus*, *Roripa sylvestris*, *Elytrigia repens*, *Chenopodium album* and *Polygonum aviculare*.

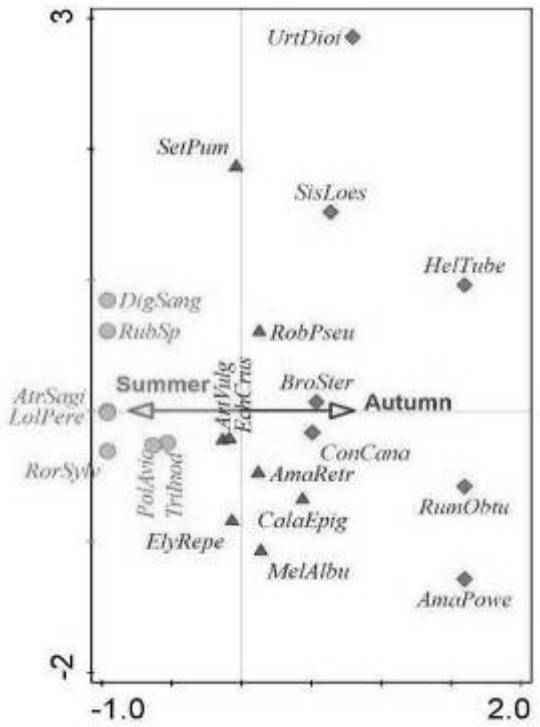

Fig. 1: Ordination diagram expressing the relation between selected species and term of evaluation

Legend: "Summer "term of evaluation in Summer. "Autumn" term of evaluation in Autumn

Tab. 1: The average coverage of species in two evaluation terms and a pollen allergen production factor

Plant species	Abbreviation	Term of evaluation (% of coverage)		Coefficient of production of pollen allergens
		Summer	Autumn	
The total coverage		61.0	45.0	
Acer negundo		0.6		3
Achillea millefolium		0.8	1.6	3
Amaranthus powelli	*AmaPowe*		4.6	5
Amaranthus retroflexus	*AmaRetr*	5.0	3.6	5

Anagallis arvensis		0.2		2
Apera spica-venti		0.6		5
Arrhenatherum elatius		1.0		5
Artemisia vulgaris	*ArtVulg*	10.0	3.0	5
Atriplex patula		0.8		5
Atriplex prostrata		0.2		5
Atriplex sagittata	*AtrSagi*	17.0		5
Avena fatua		1.8		5
Ballota nigra		0.2	2.0	3
Bromus sterilis	*BroSter*	5.0	7.6	5
Calamagrostis epigejos	*CalaEpig*	1.0	2.0	5
Capsella bursa-pastoris		0.2		3
Carduus acanthoides		0.6		3
Cirsium arvense		0.2		3
Convolvulus arvensis		0.4	0.4	2
Conyza canadensis	*ConCana*	1.2	3.0	3
Crepis biennis		0.2	1.0	3
Dactylis glomerata		0.6		5
Daucus carota		1.6		2
Descurainia sophia			1.6	2
Digitaria sanguinalis	*DigSang*	2.0		5
Dipsacus fullonum		0.2		2
Echinochloa crus-galli	*EchCrus*	6.2	4.4	5
Elytrigia repens	*ElyRepe*	5.2	1.4	5
Erigeron annuus		0.2		3
Erodium cicutarium			0.6	2
Euphorbia helioscopia		0.6	0.2	3
Festuca rubra			1.0	5
Fumaria officinalis			0.2	3
Galinsoga parviflora		0.2		3
Galium aparine			1.0	2
Geranium pusillum			0.4	3
Helianthus tuberosus	*HelTube*		5.0	4
Chelidonium majus		0.4		2
Chenopodium album		6.6		5
Lactuca serriola		1.8	2.0	2
Lamium purpureum			0.2	2
Ligustrum vulgare		2.0		2
Lolium perenne	*LolPere*	3.0		5
Malus domestica		2.0		3
Malva neglecta			0.4	2
Medicago lupulina		0.2		3
Melilotus albus	*MelAlbu*	1.6	3.0	3
Papaver argemone			0.6	3
Papaver rhoeas		0.4		3
Papaver somniferum		0.2		3
Persicaria lapathifolia		0.4		3
Phragmites australis		0.2		5
Picris hieracioides		0.2		4
Plantago lanceolata		1.0		5
Plantago major		0.2		5
Poa annua			1.0	5
Polygonum aviculare	*PolAvic*	9.6	1.0	3
Prunus avium		4.0		2
Reseda lutea		0.6		2
Robinia pseudacacia	*RobPseu*	3.0	1.0	4
Roripa sylvestris	*RorSylv*	11.6		3
Rosa canina		1.0		3
Rubus sp.	*RubSp*	6.0		3
Rumex obtusifolius	*RumObtu*		3.2	5

Setaria pumila	*SetPum*	3.2	2.6	5
Silene latifolia		0.2		2
Sinapis arvensis			0.6	3
Sisymbrium loeselii	*SisLoes*	1.2	4.0	2
Sisymbrium officinale			4.2	2
Solanum lycopersicum		0.6	1.0	2
Solanum nigrum		0.4	1.0	2
Sonchus asper		1.4		3
Sonchus oleraceus			0.4	3
Symphytum officinale			1.0	2
Tanacetum vulgare		1.0		2
Thlaspi arvense			1.0	3
Trifolium hybridum		0.2		2
Trifolium repens		0.2		2
Tripleurospermum inodorum		8.6	0.6	3
Triticum aestivum		0.2		4
Urtica dioica	*UrtDioi*	0.2	2.0	5
Verbascum densiforum			1.0	2
Verbascum thapsus		0.6		2
Veronica hederifolia			0.4	3
Veronica persica			0.4	3
Veronica polita		0.2	0.6	3

Tab. 2: The number of plant species found by the rate of production of pollen allergens

Production of pollen allergens		The number of species	Percentage
1	Plant species without pollen production	0	0,0
2	Plant species insignificant in terms of the types of pollen allergy	25	29.8
3	Producers of weak allergenic pollen	31	36.9
4	Producers of highly allergenic pollen only in a short period of time	4	4.8
5	Producers of highly allergenic pollen over a longer period	24	28.6

Conclusion

During the monitoring, it was found 84 plants species from which 29% are allergenic pollen producing species. The occurrence of pollen-producing species varies during the growing season. The results show that plants at the landfill of municipal waste can represent a significant source of allergenic pollen and thereby reduce the quality of life in the area. Pollen of plant can spread over kilometer distances. As a result, the quality of life of people in the area may deteriorate and their activities in the landscape can be reduced.

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Souhrn
Rostliny jsou v krajině vnímány jako pozitivní prvek. Ovšem řada druhů produkuje pyl způsobující alergické reakce. Cílem práce je tedy stanovit a určit druhovou diverzitu rostlin schopných udržet se na aktivní skládce a podíl alergenních druhů. Terénní pozorování probíhalo na skládce komunálního odpadu v katastrálním území Nětčice (Zlínský kraj, ČR). Vyhodnocení vegetace bylo prováděno metodou fytocenologických snímků. Z nalezených druhů rostlin byly vybrány ty druhy, které produkují pyl způsobující alergie. Celkem bylo nalezeno 84 rostlinných druhů. Mezi druhy rostliny rostoucí na skládce a produkující alergenní pyl patří: *Amaranthus retroflexus, Apera spica-venti, Arrhenatherum elatius, Artemisia vulgaris, Atriplex hortensis, Atriplex patula, Atriplex prostrata, Atriplex sagittata, Avena fatua Bromus sterilis, Calamagrostis epigejos, Dactylis glomerata, Digitaria sanguinalis, Echinochloa crus-galli, Elytrigia repens, Chenopodium album, Juglans regia, Lolium perenne, Plantago lanceolata, Plantago major, Robinia pseudacacia* a *Urtica dioica.* Pyl rostlin se může šířit na kilometrové vzdálenosti. Díky tomu se může zhoršovat kvalita života lidí v okolí a omezovat jejich aktivity v krajině.

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VEGETATION OF CHOSEN RECULTIVATED MUNICIPAL WASTE LANDFILL AND THEIR AESTHETIC VALUE IN THE LANDSCAPE

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Abstract
The vegetation at a recultivated landfill should create a continuous string of vegetation in order to prevent the erosion of the soil brought, and the roots of the vegetation must not grow into the body of the landfill itself. However, vegetation has also its aesthetic value and affects perception of man. The aim of this work was to determine the species composition of plants that are able to sustain themselves in an active landfill in Nětčice (Zlín Region, Czech Republic) and to assess the aesthetic value of the plant species found. The evaluation of the vegetation was carried out using the phytocenological imaging method. For each plant species found, its aesthetic value was assessed. Altogether 68 plant species were found. Found plant species that have a high aesthetic value are: *Achillea millefolium*, *Allium rotundumi*, *Calamagrostis epigejos*, *Campanula rapunculoides*, *Carduus acanthoides*, *Cirsium arvense*, *Convolvulus arvensis*, *Lathyrus pratensis*, *Lathyrus tuberosus*, *Linaria vulgaris*, *Melilotus albus*, *Melilotus officinalis*, *Tragopogon dubius*, *Trifolium aureum*, *Trifolium hybridum*, *Trifolium pratense*, *Tussilago farfara*, *Vicia cracca*, *Vicia tetrasperma*. High proportion of plant species with high aesthetic value can improve the overall perception of the landscape.

Key words: Plant species, municipal waste landfill, biodiversity, phytosociological methods, recultivation

Introduction

At the landfills we can find poor plants species communities, but with a high proportion of ruderal species. The vegetation here can created the cover function primarily (Tintner, Klug, 2011). The specific conditions of each recultiveted area should be taken into account when recultivation and use of specific plant species (Kirmer et al., 2008).
The vegetation at a recultivated landfill should create a continuous string of vegetation in order to prevent the erosion of the soil brought and the roots of the vegetation must not grow into the body of the landfill itself. However, vegetation has also its aesthetic value and affects perception of man. The aim of this work was to determine the species composition of plants that are able to sustain themselves in an active landfill.

Materials and methods

The work was conducted in the cadastral area Nětčice. The Area is located in a triangular space delimited by main roads connecting the villages of Zdounky, Nětčice and Troubky-Zdislavice. It is a sanitary landfill incorporated with multilayer composite bottom liner, leachate and landfill gas collection system, and a final cover

system. In terms of maintenance, the landfill is classified in the S-category - other waste, sub-category S-OO3 (Vaverková et al. 2012).
The area belongs in the Kojetín bioregion (Culek, 1996) situated in central Moravia and occupying the geomorphological subunit of Central Moravia Floodplain. The bioregion is formed by a broad alluvial plain with regulated rivers. Biota is of azonal character and dominated by agrocoenoses, preserved floodplain forests, remainders of meadows and ponds with abundant fauna. According to Quitt (1971), the entire region lies in the warm zone T2. Weather is warm with abundant precipitation.
Within the land with a recultiveted part of the landfill, the vegetation evaluation was carried out in two dates in July 2017 (Summer) and in October 2017 (Autumn). The evaluation of the vegetation was carried out using the phytosociological plots. The size of phytosociological plots were 20 m^2. The coverage was estimated as a percentage. Altogether twenty four phytosociological plots were recorded. The scientific names of each weed species were used according to Kubát (Kubát et al. 2002).
The evaluation of the coverage of the species found and the evaluation term was carried out using multidimensional analyses of ecological data. The choice of optimal analysis was based on the length of the gradient (*Lengths of Gradient*). The length of the gradient was determined using segmental analysis DCA (*Detrended Correspondence Analysis*). Next were used Redundancy analysis (RDA), which is based on the linear response (*Linear Response*).
Subsequently, the species were divided into three groups according to their aesthetic value.
The groups are as follows:

- HIGH (potential high aesthetic value): plant species with conspicuously colourful flowers increasing the aesthetic value of bio-belts,
- MEDIUM (potential medium aesthetic value): plant species with colourful flowers, but of smaller size, smaller flowers, low contrast of flowers of the crop, with spiny stems and leaves, ornamental invasive plants or due to other reasons plants increasing less the aesthetic value in awareness of people,
- LOW (potential low aesthetic value): inconspicuous plant species, plant species with featureless flowers (for example grasses).

Results

A total of 68 plant species were found. Found plant species with HIGH (high potential aesthetic value) are: *Achillea millefolium, Allium rotundum, Campanula rapunculoides, Carduus acanthoides, Cirsium arvense, Convolvulus arvensis, Crepis biennis, Daucus carota, Dipsacus fullonum, Erigeron annuus, Falcaria vulgaris, Galium album, Geum urbanum, Heracleum sphondylium, Hippocrepis comosa, Hypericum perforatum, Lathyrus pratensis, Lathyrus tuberosus, Linaria vulgaris, Melilotus albus, Melilotus officinalis, Picris hieracioides, Ranunculus acris, Reseda lutea, Securigera varia, Sisymbrium officinale, Symphytum officinale, Tanacetum vulgare, Taraxacum* sect. *Ruderalia, Tragopogon dubius, Trifolium aureum, Trifolium hybridum, Trifolium pratense, Tripleurospermum inodorum, Tussilago farfara, Verbascum densiforum.*
Found plant species with MEDIUM (potential high aesthetic value) are: *Acer negundo, Arctium tomentosum, Calamagrostis epigejos, Capsella bursa-pastoris, Plantago lanceolata, Rosa canina, Rubus sp., Rumex crispus, Sanguisorba officinalis, Setaria pumila, Vicia cracca, Veronica hederifolia, Veronica chamaedrys Veronica persica, Vicia tetrasperma*

Found plant species with LOW (potential high aesthetic value) are: *Arrhenatherum elatius, Artemisia vulgaris, Astragalus glycyphyllos, Dactylis glomerata, Elytrigia repens, Euphorbia esula, Euphorbia helioscopia, Festuca pratensis, Festuca rubra, Festulolium, Chenopodium album, Lolium perenne, Phleum pratense, Phragmites australis, Poa pratensis, Salix caprea, Urtica dioica.*
The number of species according to the aesthetic value and the percentage of coverage according to the categories of potential aesthetic values are shown in Table 1.

Tab. 1: Share of coverage and number of plant species in two evaluation terms

Potential aesthetic value	Share on the coverage		Number of plant species	
	Summer	Autumn	Summer	Autumn
HIGH (potential high aesthetic value)	41.0%	30.2%	27	25
MEDIUM (potential medium aesthetic value)	12.5%	18.3%	9	12
LOW (potential low aesthetic value)	46.4%	51.5%	13	13

The results of the influence of the term on vegetation were first processed by DCA analysis. Based on this processing was obtained the length of the gradient, and it was 2.85. The length of the gradient is decisive for further analysis. Based on this calculation for further processing was selected Redundancy analysis (RDA). The results of the RDA analysis evaluating the term of evaluation and plant species are significant at the significance level $\alpha = 0.001$ for all canonical axes and are therefore statistically significant. This is subsequently graphically expressed by the ordination diagram (see Fig. 1).

Discussion
Our results show that species with high aesthetic value are relatively high representation. The share of coverage of these species is 41% in the summer evaluation and falls to 30% in autumn evaluation. The number of species is the highest of the monitored groups. It leads to the premise that a recultiveted landfill can increase the aesthetic value of the entire landscape. This can also reduce the negative impact of the municipal landfill on the surrounding area.
RDA analysis results indicate that the proportion of species with the highest of coverage during the term monitoring (summer, fall) does not change much. Most plant species reach similar coverage in both evaluation terms. From plant species with a high potential aesthetic value, they are above all *Achillea millefolium, Cirsium arvense, Galium album, Melilotus albus, Securigera varia, Symphytum officinale, Tussilago farfara.* In the summer term, the plant species *Lathyrus pratensis* is more prominent.

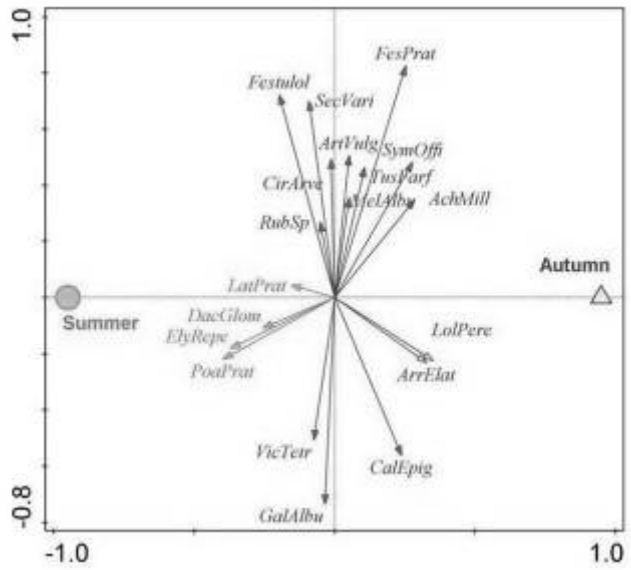

Fig. 1: Ordination diagram expressing the relation between selected species and term of evaluation

Legend: *"Summer "term of evaluation in Summer. "Autumn" term of evaluation in Autumn AchMill – Achillea millefolium, ArrElat – Arrhenatherum elatius, ArtVulg – Artemisia vulgaris, CalEpig – Calamagrostis epigejos, CirArve – Cirsium arvense, Dac Glom – Dactylis glomerata, ElyRepe – Elytrigia repens, FesPrat – Festuca pratensis, Festulol – Festulolium, GalAlbu – Galium album, LatPrat – Lathyrus pratensis, LolPere – Lolium perenne, MelAlbu – Melilotus albus, PoaPrat – Poa pratensis, RubSp. – Rubus sp., SecVari – Securigera varia, SymOffi – Symphytum officinale, TusFarf – Tussilago farfara, VicTetr – Vicia tetrasperma.*

Conclusion

A total of 68 plant species were found. A total of 36 plant species with high potential aesthetic value were found. These species contributes to the total coverage of 35 %. The most common species were *Achillea millefolium, Cirsium arvense, Galium album, Lathyrus pratensis*, *Melilotus albus, Securigera varia, Symphytum officinale* and *Tussilago farfara.* It is clear from the results that the recultivated landfill has the potential to increase the aesthetic value of the landscape. This makes it possible to reduce the negative perception of the municipal waste landfill. However, it is necessary to realize that the species spectrum in vegetation is subject to natural development and is also influenced by the quality and type of maintenance. Therefore, it is necessary to monitor the further development of vegetation coming years.

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Souhrn
Vegetace na rekultivované skládce má vytvořit souvislý porost, aby došlo zamezení eroze navezené zeminy, dále nesmí prokořenit do vlastního tělesa skládky. Vegetace ovšem má také svou estetickou hodnotu a ovlivňuje vnímání člověk. Cílem práce bylo určit druhovou skladbu rostlin rostoucích na rekultivované skládce v Nětčicích (Zlínský kraj, ČR) a posoudit estetickou hodnotu nalezených druhů. Vyhodnocení vegetace bylo prováděno metodou fytocenologických snímků, u každého nalezeného druhu byla posouzena jeho estetická hodnota. Celkem bylo nalezeno 50 rostlinných druhů. Nalezené druhy rostlin, které mají vysokou estetickou hodnotu jsou *Achillea millefolium, Allium rotundum, Calamagrostis epigejos, Campanula rapunculoides, Carduus acanthoides, Cirsium arvense, Convolvulus arvensis, Lathyrus pratensis, Lathyrus tuberosus, Linaria vulgaris, Melilotus albus, Melilotus officinalis, Tragopogon dubius, Trifolium aureum, Trifolium hybridum, Trifolium pratense, Tussilago farfara, Vicia cracca, Vicia tetrasperma.* Vysoké zastoupení druhů rostlin s vysokou estetickou hodnotou zlepší celkové vnímání krajiny.

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VISITOR MONITORING OF PROTECTED AREAS IN THE CZECH REPUBLIC AND ABROAD

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Abstract
This paper delivers latest findings of the visitor monitoring results from chosen Protected Areas (PA's) of the Czech Republic for the year 2017. This contribution further compares visitor monitoring results from the Czech PA's with the numbers of visits of known and less well-known PA's abroad. Finally we discuss the economic potential of the Czech PA's in the context of their recent annual visits.

Key words: visitor counting, economic impacts, visitor management, tourism

Introduction

The origins of the systematic visitor counting in Czech PA's can be dated back to the year 2005. In that year the management of the NP České Švýcarsko began to carry out a systematic visitor monitoring of their NPs most attractive sites. Since then the management of the NP has been able to present well founded and reliable information on the intensity of tourism in its territory. In 2009 the administrations of Beskydy and Jeseníky Protected Landscape Areas also began to count their visitors using the means of year-round automatic counting. Among the pioneers of the automatic visitor counting in Protected Landscape Areas belongs also the administration of the Křivoklátsko PLA. The data from year-round automatic counting about the number of visits in protected areas is currently used by two thirds of the protected areas in the category PLA (Protected Landscape Areas) and NP (National Parks) (Zahradnik et al., 2017). In 2015 was published a paper in PLOS Biology which compared the number of visits from Protected Areas worldwide. Despite the fact, that the methods of obtaining data used in the study vary widely (include dedicated studies, gate receipts, and automated trail and road counts, etc.), the work still remains the most comprehensive text addressing visitor numbers in Protected Areas worldwide. When confronting the numbers of visits in Czech PA's with the visitor numbers found abroad, two following facts are evident. The first one is that the number of visitors in Czech Protected Landscape Areas and National Parks is comparable and sometimes even higher than the visit rates in many renowned National Parks of worldwide fame. The second one is that the Protected Areas have, due to their often surprisingly high visit rates, an unsuspected economic potential.

How many people visit protected areas in the Czech Republic and abroad?

While working with data about visitor traffic it is important to keep in mind following fact. The number of visitors, both in Czech and abroad, shows a growing trend (Zahradník, Banaš 2016). The analysis of author's several years long dataset on numbers of visits demonstrates, that even few years old results can show multiple difference compared to the current traffic, for example the recorded number of passing visitors on the northern access to the peak of Lysá hora Mt. (Beskydy PLA) in 2010 was 58,970. The most recent data from 2017 reports the number of 155,038 passing visitors (author's dataset, see Fig.2). Visitor monitoring data have very fast

dynamics and (unfortunately) also the tendency to become obsolete. In general, we can say that visitor monitoring data older than 10 years are no longer relevant. The Balmford et al. paper (2015), which currently represents the only comprehensive source of its kind, and simultaneously the only available source of data for many Protected Areas, operates with dataset for the period 1998-2007.
Figure 1 provides an overview of the most visited PA's according to Balmford et al. (2015) listed by continents (top three for each continent). As a telling example of visitor numbers dynamics can be used Machu Picchu (Historic Sanctuary of Machu Picchu, Peru). Balmford et al. (2015) operate with numbers of visitors from the year 2007 (691,623 visitors), whereas nine years later, in 2016, the number of visitors has been already 1.4 million (Coldwell, 2017).

Rank	Protected Area	Country	Annual visit rate mean, 1998–2007
North America			
1.	Golden Gate National Recreation Area	US	13 722 413
2.	Lake Mead National Recreation Area	US	7 765 579
3.	Delaware Water Gap National Recreation Area	US	5 050 877
Europe			
1.	Lake District National Park	UK	10 500 000
2.	Peak District National Park	UK	10 100 000
3.	North York Moors National Park	UK	7 300 000
Africa			
1.	Cape Peninsula National Park	South Africa	1 462 649
2.	Kruger National Park	South Africa	1 000 000
3.	Victoria Falls/Mosi-oa-Tunya	Zimbabwe	300 000
Asia			
1.	Seoraksan National Park	South Korea	3 060 286
2.	Mount Huangshan	China	1 340 000
3.	Wuyishan Scenic Area	Thailand	1 266 000
Australia			
1.	Gondwana Rainforests of Australia	Australia	510 000
2.	Uluru-Kata Tjuta National Park	Australia	380 000
3.	Litchfield National Park	Australia	273 000
Latin America			
1.	Tijuca National Park	Brazil	737 039
2.	Historic Sanctuary of Machu Picchu	Peru	691 623
3.	Puyehue	Chile	304 243

Fig. 1: Most visited Protected Areas listed by continents (source: Balmford et al., 2015).

Apparently the most visited Protected Area of Czech Republic is the Krkonoše National Park. The current number of its visitors is around 5.4 million persons annually (KRNAP, ©2017). How does this number compare with the data found in famous National Parks abroad? For example the number of visitors recorded in 2016 in Yellowstone National Park was 4.3 million (National Park Service, ©2017). Grand Canyon National Park was in the same year visited by 5.97 million people (statista, ©2018). According to annual visit list of Protected Areas (Balmford et al 2015) the Yellowstone National Park was ranked 18th and the Grand Canyon National Park 9th in the most visited PA's. Assuming that the number of visitors in 20 most visited Protected Areas all over the world grew more or less evenly and therefore the order in ranking could be still valid, the Krkonoše National Park would

belong among the 20 most visited world PA's. That is to say that the number of visitors of Krkonoše NP would have surpassed even so renowned National Parks as for example Rocky Mountain National Park (USA), Tatranský National Park (Slovakia) or Cape Peninsula National Park (South Africa). Other Czech Protected Areas are already visited significantly less or there is no comprehensive data about the visitor traffic for the whole territory. In the last years interesting visitor monitoring results can be found for example in Beskydy PLA. While taking in account just two monitored sites from the upper parts of Beskydy Mountains (the summit of Lysá hora and the ridge path of Radhošť) in 2017 we can reach a number of 507,509 visitors in total. In the same year National Cultural Monument - Wallachian Open Air Museum lying also in Beskydy PLA attracted 302,000 visitors (vmp, ©2017). Taking in consideration the existence of a number of other significant tourist attractions in the area (e.g. Pustevny mountain saddle) it is almost certain that more than 1 million visitors visited the PLA Beskydy in 2017.

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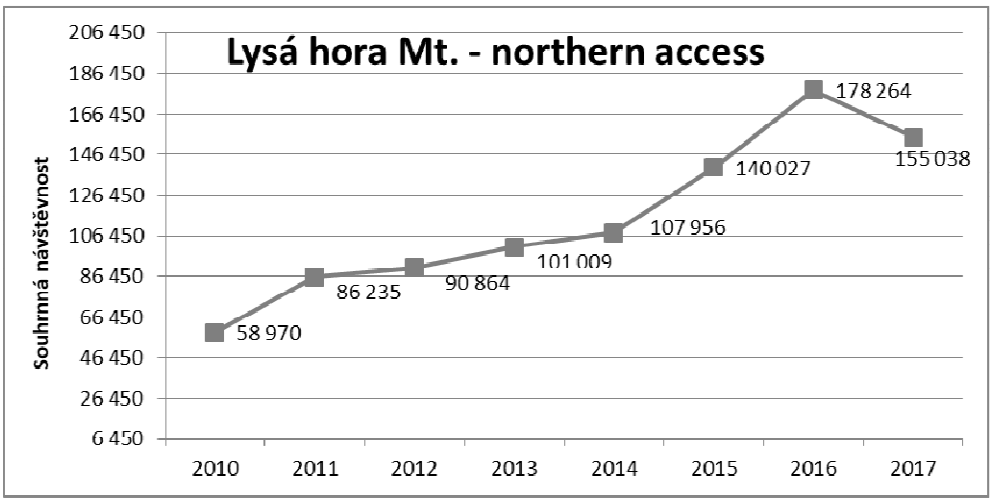

Fig. 2: Traffic development on the northern access to the peak of Lysá hora Mt. in the Beskydy PLA

The most visited Protected Areas of the Czech Republic (e.g. Krkonoše NP, Beskydy PLA, České Švýcarsko NP and others) reports on average higher recorded numbers of visitors than the most visited PA's in Australia or Latin America. This corresponds to a pan-European trend, because from the estimated number of 8 billion visits for all terrestrial PA's, nearly half of this number (3.8 billion people) belongs to European Protected Areas (Balmford et al., 2015). In densely populated Europe, the positive dependence between the visitor traffic of the PA and the number of inhabitants living within 100km of PA's perimeter applies more than in other continents (Balmford et al., 2015). This is the main reason why Czech PA's, despite their small size, show above-average visitor numbers worldwide. We can demonstrate this fact in Podyjí National Park. This national park, with area 63 km², was visited by approximately 425,000 visitors in 2006 (Kos, 2007). That is to say, there were 6,746 visitors for one km² in the Podyjí NP. The Salamajärvi National Park in Finland has practically the same area (62 km²) but it has a high degree of remoteness and it's uninhabited. Visitor traffic of this NP in 2006 was 12,000 visitors (Balmford et al., 2015). That means 194 visitors for 1 km². In terms of visitors per

unit area, this remote Scandinavian park has about 35 times lower visitor traffic than the Podyjí National Park in central Europe. In the Czech Republic probably the most intense visitor traffic in relation to the unit area can be found in České Švýcarsko National Park. In 2016, it was visited by at least 750,000 visitors (npcs, © 2017). With the area of the park 79 km², the visitor rate per 1 km² is incredible 9,494 visitors annually.
Other interesting findings can be obtained by the comparison of visitor traffic for karst protected areas or single specific caves. The visitor traffic in Škocjanské jeskyně caves (natural and cultural heritage of UNESCO, Slovenia) is lower than 100,000 visitors annually (Jurinčič, Balažič, 2010), while according to the analysis of cave visitor traffic in the Moravský Kras PLA (Czech Republic) between 1998-2007, the Punkevní jeskyně caves had average annual visitor traffic of more than 207,000 visits (Kolářová, 2009).

Economic potential of protected areas

Total annual visitor traffic of protected areas in the world (approximately 8 billion visitors) directly generates at least US $600 billion for local economies (Balmford et al., 2015). The issue of quantifying economic benefits, which result from protected areas, is generally highly topical. The first surveys of NGOs in the Slovak Republic found out that Muránska Planina National Park is able to generate a profit of EUR 10 million per year for the Slovak economy. Half of this amount is in fact made up of money invested by tourists during their visit in the park. Veľká Fatra National Park generates annually value of EUR 62 million, Slovak Paradise National Park approximately EUR 156 million (Barát, 2015). These demonstrative figures disprove generally accepted idea which says that nature conservation does not make any money and it only consumes them. On the other side, the direct proportion that higher number of tourists brings higher profit does not apply here. At least not unconditionally. Growing number of visitors of the protected areas also means growing impact on the natural environment, which is particularly noticeable in vulnerable types of environment such as mountain ecosystems (Švajda et al., 2015, Popelka et al., 2016). Afterwards, we can as a consequence observe increased costs spent on remediation of negative traces left in the area by visitors. Despite the fact that the global number of tourists is growing and despite the profits it brings, the estimated worldwide annual government investment in protected areas is only US $10 billion (Balmford et al., 2015). This means that investment makes about 1.7 % of estimated profit. The question of entrance fee to the most valuable natural sites belongs among one of the long-standing issues in the Czech Republic. It is practically not used by state nature conservation. Furthermore, the state nature protection is forced to spend considerable resources in a number of sites due to their high visitor traffic in order to prevent damage to the environment as well as to secure basic safety of visitors. One of many examples is the Bílá Opava valley in the Jeseníky PLA. In 2014 and 2015 the PLA Jeseníky Administration invested CZK 1 million into local tourism infrastructure. The up-to-date monitoring data (2017) in the Bílá Opava valley exceed the figure of 100,000 visitors. Even a symbolic entrance fee of CZK 30, similar to the nearby nature trail Rejvíz, would yearly bring back the investment threefold. As an illustration, we can use an example from the Polish side of the Tatra National Park where the gate receipts can cover up to 80 % of the protected area management costs (Getzner, 2010).

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Souhrn
Text konfrontuje data o návštěvnosti vybraných českých chráněných území s informacemi ze zahraničních chráněných území a parků. Aktuální data o návštěvnosti v kombinaci s údaji publikovanými kolektivem autorů z univerzity v Cambridge ukazují, že národní park Krkonoše s ročním odhadem návštěvnosti kolem 5,4 milionu návštěvníků patří mezi dvacet nejnavštěvovanějších chráněných území světa. Řada českých chráněných území, pro něž jsou k dispozici data o návštěvnosti (Krkonoše, České Švýcarsko, Podyjí, Beskydy, aj.) mají v průměru vyšší návštěvnost než nejnavštěvovanější chráněná území Austrálie či Jižní Ameriky, a to navzdory jejich mnohdy nevelké rozloze. V kontextu dat o návštěvnosti se autoři článku rovněž zamýšlejí nad ekonomickým potenciálem chráněných území a hypotetickým přínosem výběru vstupného v nejcennějších přírodních lokalitách.

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WATER MANAGEMENT AT THE MUNICIPAL FOOTBALL STADIUM IN BRNO

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Abstract
Rainwater management is currently a very hot topic not only in the Czech Republic, but in most of the developed countries. The main problem we are facing is the constant expansion of urban areas that causes disruption of the natural water cycle. Rainwater is often viewed as a negative since in number of places it can cause local flooding due to the insufficient sewerage capacity. On the other hand, the problem of drought is being solved actively and prevention being implemented. Often, rainfalls could locally solve the situation in urban areas were they effectively used in this area. Currently, there are a number of towns and municipalities, where rainwater is managed in accordance with principles of sustainable development, but also we can find many urban areas, where rainwater is only harmlessly and promptly taken away from the territory. This is the case of the Municipal Football Stadium in Brno.

Key words: green infrastructure, irrigation of sports fields, rainwater

Introduction

In the last decades, the classic and long-lasting method of drainage (ie the quickest removal of sewage and rainwater from intravilan) seems to be permanently unsustainable and a number of projects are being developed to deal with this issue. Use of rainwater, its retention and infiltration is of great importance. The use of rainwater for non-drinking water quality purposes supports the saving of drinking water and the protection of its sources. At the same time, the drainage flow in the sewage system is reduced, the hydraulic load and the cloudiness of the WWTP in the rain decrease. Infiltration also contributes to the recovery of groundwater reserves [1]. The possibility of using little polluted rainwater is a whole range, among the most important ones are

- irrigation of green areas in housing estates, sports grounds, gardens,
- washing water - cars, construction machines, industrial areas and others,
- household use - flushing, washing,
- in industry.

At the same time, it is necessary to ensure that the population is supplied with drinking water. In developed countries, people often do not realize how long the water has to go from the water source and what processes to go through. They take it for granted that drinking water is available in unlimited quantities.
It should be emphasized that the use of rainwater is not a "discovery" of recent years and our ancestors could use them economically. As stated in [2], there were so-called "cisterns" in the antiquity - underground tanks with volumes up to 1,000 m^3.For example, many residential houses in the Roman Empire had open tanks for rainwater from the roofs. Water overflows have fallen into underground tanks protected against evaporation and pollution. Also in Venice there were more than 4,500 rainwater tanks, each serving for the supply of potable water, until the introduction of the central drinking water supply in the 19th century.

Today, large rainwater tanks are built in a number of modern cities around the world. In the Sports arena in Tokyo there is a 3,000 m^3 of rain water tank, which serves to supply toilets, and six tanks for 100 m^3 at Frankfurt airport [3].
In 2009, an enormous underground cistern for 400,000 m^3 of rainfall was built in Madrid as part of "The Manzanares River Improvement Project", which is one of the largest in the world. All precipitation waters are captured here; they are gradually taken to the WWTP and then discharged into the Manzanares River. There is a golf course on the surface and parking on the first floor [4].

Legislation
The issue of rainwater and the treatment of rainwater is addressed in our legislation by a number of legal regulations:

- Act No. 254/2001 Coll. on Water and on the Amendment to Certain Acts
- Decree No. 268/2009 Coll. On Technical Requirements for Buildings
- Act No. 274/2001 Coll., On Public Water Supply and Sewerage and on Amendments to Certain Acts
- Decree No. 501/2006 Coll. on General Requirements for the Use of Area

Legislation defining the rules for a new method of drainage of urbanized areas according to the principles of sustainable development is enshrined in laws and decrees not systematically and uncoordinated and often without an understanding of wider contexts. In many cases, there is no uniform interpretation of the legislation in force, and often there are buildings with inappropriate drainage. The distrust of the authorities concerned to promote a new drainage concept and its inadequate requirement for builders is an indirect consequence [5].

Characteristics of the area of interest and methodology of the solution
The football stadium is located in the Brno - Královo Pole district. The Statutory City of Brno is the owner of the stadium and FC Zbrojovka Brno rents the stadium from the city. The main football field with tribunes and two training courses are part of the sports complex. In the immediate vicinity is the old and new City Sports Hall and an outdoor ice rink (Fig. 1). In 2016, a roofed tribune was built at the main playground with a total area of 2,526 m^2, which made the stadium on Srbská meet the conditions for holding first league matches. The Statutory City of Brno was the investor of this building; the price excluding VAT amounted to CZK 13,285,496 [6].
The rainwater from this stand is, according to information from the Department of Territorial and Construction Management of the Office of the Brno-Královo Pole Office, drained into the rainwater sewerage system, which is connected to the existing site drainage uniform sewer system. Some rainfalls are connected directly to the sewerage system, other via a 6.5 m^3 retention tank. When building an umbrella stand, the use of rainwater was not solved, especially with regard to the budget possibilities of the construction itself. It was supposedly not possible to implement rainwater from the stands in this location.
All three grass fields are irrigated with potable water during the growing season, irrigation runs from April to October. During April, May and October, it is irrigated as needed, in the summer; regular irrigation is set after 3-4 hours according to the current state, i.e. "window view" and eventually weather forecasts. It often happens that the irrigation starts even when it rains. No lawn moisture sensors that trigger automatic irrigation are installed.
A meteorological data from the TeranosALA stations [7] for the MU Faculty of Arts, Arne Novák Street in Brno, where the annual rainfall is 437mm, was used to

calculate the rainfall for the year 2016 for the site. Furthermore, the sum of watertight areas in the area, which could be used to contain precipitation water (Fig. 1), was calculated:

- new tribune with total area: 2,526 m^2
- roofs of both city sports halls with a total area of 5,903 m^2
- the old tribune with area 994 m^2

The total amount of waterproof areas: 9,423 m^2

Data on water and sewer rates were obtained on the website of Brněnské vodárny a kanalizace, a.s. [8]. The administrator of FC Zbrojovka Brno provided data on the total consumption of drinking water for irrigation.

On the basis of this data, it is possible to calculate the amount for potable water for irrigation of the courses for one vegetation period and also the sewer rate for the drainage of rainwater into sewerage. Furthermore, the total amount of rain water that can be retrieved from the impervious areas and further utilized is calculated.

Results and proposal for the use of rain water

The above-mentioned method of handling rainfall in the sports complex on Srbská Street in Brno is very non-economic and not ecological. Therefore, a theoretical study on rainwater management for this sports facility was developed. During the season, approximately 7,000 m^3 of drinking water is consumed for irrigation of two training courses and 5,500 m^3 for irrigation of the main course. At the water price of 36.78 CZK.m^{-3} for the year 2016 [8] and for 2016 FC Zbrojovka Brno paid CZK 459,750 for drinking water needed for irrigation of lawns. In the study, the cost of the sewer rate for 2016 was also calculated for the drainage of rainwater from the new tribune to the sewerage. With an area of 9,423 m^2, an annual rainfall of 437 mm [7], and a yearly 38.36 CZK.m^{-3} for the year 2016 [8] is thus CZK 158,111.

If rainwater storage tanks were built inside the area, it would be possible to use this water at least for partial irrigation of the lawns. With a total impervious area of 9,423 m^2 and an annual rainfall of 437 mm, there are approximately 4,100 m^3 of rainfall per year caught.

The study identified three sites in the immediate vicinity of the football stadium (Fig. 1), where it would be possible to build underground rainwater reservoirs. Tank No. 1 could be located next to the upper training ground in a location that is currently unused and often polluted with discarded litter. At the same time, a park could be built on the surface. This site is owned by the Statutory City of Brno. The second tank is designed at the lower training ground in its immediate vicinity. It is also an unused location, where football goals are only occasionally stored. The water from the roofs of both city sports halls would be gravitationally led to these two tanks. The third tank would capture the rainwater from the new and old tribune and be located next to the main course (Fig. 1). At present, this area is used for football matches as organizer's and security components. The proposal foresees the construction of underground tanks, so the functionality of this area would be maintained. It would be appropriate to place the tank so that it is out of the way where the safety components of the vehicle are parked and moved so that the cost of building the tank is not increased.

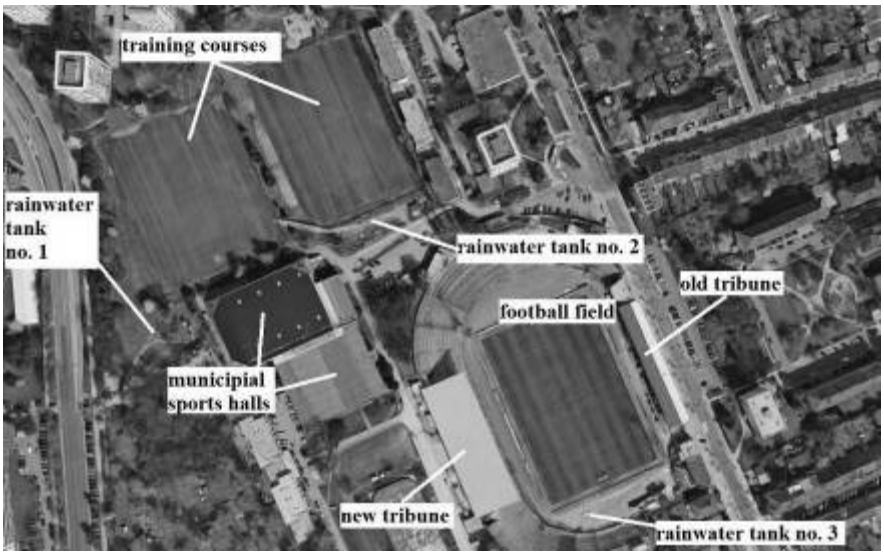

Fig. 1: Area of interest - football stadium and its surroundings (www.www.google.com, edited by the author)

A proposal for a method of irrigation of lawns in playgrounds is part of a water management study in the football stadium area. Litschmann [9] presents various possible options for optimal irrigation management. These are the most common:
• manual,
• temporal,
• temporal with blocking in case of rain and
• based on soil moisture.
The most economical methods include soil moisture management. The irrigation is carried out on the basis of the amount of moisture in the soil, which is decisive for supplying the lawn with water, while reflecting weather influences (atmospheric leakage, dropped precipitation), the amount of irrigation water delivered and the effects of permeability or impermeability of the subsoil. The whole device consists of a soil moisture sensor, which is to be placed on a representative spot in the lawn, typical for the largest area of the irrigated vegetation. The irrigation is then carried out at a predetermined time only if the soil moisture is below the set limit. This mode of control has the advantage of not requiring any collision information, irrigation water and evapotranspiration, which is therefore most user-friendly and needs to be checked only occasionally [9]. Research on water savings in irrigation controlled by various methods is reported in [10]. Their results showed that under residential conditions, the soil moisture sensor systems decreased the water application by 65% compared to homes with automated irrigation systems without sensor feedback.
The total amount of potable water consumed for irrigation in the sports complex on Srbská Street in Brno is around 12,500 m^3 per season. If soil moisture sensors were installed in the lawns to trigger irrigation, the irrigation water consumption could be reduced by 50 % - 65 %, ie to 6,250 m^3 - 4,375 m^3 per season. The captured amount of rainwater in the tanks would be around 4,100 m^3. In this mode of management, the consumption of potable water on irrigation would be significantly reduced to a maximum of 2,000 m^3 - depending on the height and distribution of

precipitation in the given growing season. At the same time, the cost of drainage of rainwater to sewerage will be reduced.
This study did not include a complete financial analysis including the cost of building underground rainwater tanks. If the Statutory City of Brno and FC Zbrojovka Brno decide for implementation, a detailed project should be developed for the location of the individual tanks including the financial analysis.

Conclusion

In recent years, we are increasingly confronted with hydrological extremes, where we alternately address the problem of "excess" rainfall, i.e. floods and "lack of" rainwater, i.e. drought. In 2015 and 2016 drought affected a large part of the Czech Republic. Separate meteorological, hydrological, soil and finally socio-economic droughts have gradually emerged in individual catchments. In the Morava river basin, the flow values were well below the long-term average in the vegetation period. Very low levels of groundwater in almost the entire Czech Republic were recorded both in the summer of 2015 and in 2016 and drought also had a significant negative impact on agricultural crops. Increasing urbanization adversely affects the natural hydrological regime of the landscape. In the Czech Republic, it is necessary to change access to rainfall waters and began to manage them instead of discharging them from the territory.

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Souhrn

Hospodaření se srážkovými vodami je v současné době velmi aktuální téma nejen v České republice, ale ve většině vyspělých států. Hlavní problém spočívá

v neustálém rozšiřování zastavěných území, přičemž dochází k narušování přirozeného koloběhu vody. Na srážkové vody je často pohlíženo negativně, protože mohou v řadě míst způsobovat lokální záplavy při nedostatečné kapacitě stokové sítě. Na druhou stranu se v dnešní době řeší velmi aktivně problém sucha a jak mu předcházet a mnohdy by, alespoň částečně, mohly lokálně situaci v urbanizovaném území vyřešit právě srážkové vody, kdyby byly v daném území hospodárně využity. V současné době existuje řada měst a obcí, které se srážkovými vodami nakládají dle principů trvale udržitelného rozvoje, ale zároveň lze nalézt mnoho urbanizovaných území, kde jsou srážkové vody pouze neškodně a co nejrychleji z území odvedeny. To je případ Městského fotbalového stadionu v Brně.

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WITNESSES OF THE CHANGES: ABANDONED SETTLEMENTS AND ITS ROLE IN REGIONAL DEVELOPMENT

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Abstract
The paper presents the research concept aimed to the Czech cultural landscape changed during several post World War II decades. Presented research is based on identifying and evaluating the role of landscape dynamics in the historical memory of local residents. This issue will be documented and presented on the example of extinct settlements in the Czech border region (identifying, documenting and reconstructing the image of the landscape and settlement structure captured in human memory and completing it with other historical sources and permanently recording it and making it accessible for the next generations). It is necessary to apply an interdisciplinary approach based on the theoretical background to understand all the contexts of the problem under consideration (causes of settlement extinction, current seat functions, influence on landscape dynamics, reflection in the perception of local inhabitants, the role of local identity, etc.) and complex interpretation of these phenomena and processes and methods of social sciences and nature science. The aim of this paper is to summarize the current state of knowledge and to increase the usability of their potential in spatial planning, tourism development and education process.

Key words: landscape memory, deserted settlement, local identity, oral history

Introduction

This text is aimed to present the research focused on physically extinct settlements in period from 1945 to 1989. Research is based on investigation a documentation of such settlements within all territory of Moravia and Silesia and in more detail within the case studies. The purpose of this paper this paper is to summarize the current state of knowledge and to increase the usability of their potential in spatial planning, tourism development and education process.
This project was supported by the Ministry of Culture Czech Republic, the project is carried out by three partners: Mendel university in Brno (Faculty of AgriScience), Institute of Contemporary History and Masaryk university (Faculty of Informatics).

Material and methods

The research methodology is based on a combination of the landscape ecological and historical research approaches. An important part of the project is working with witnesses. Selected interviews with witnesses will be uploaded. The outputs will take the form of short audio-visual documents consisting of audio recording and video material - video recordings, current photographs, historical photos of the described territory, other graphic materials (2D maps of the changes of the landscape structure and the 3D model of the settlements in the context of the surrounding landscapes).
Three microregions were chosen for a more detailed research – Bruntál, Jeseník and Šumperk (north eastern part of Czech Republic).

Current state of knowledge

Primarily the fields such as archeology and geography deal with the research of the extinct settlements, but also other scientific disciplines such as anthropology, demography, ecology and environmental studies, ethnography, historiography, cartography, culture, sociology or urbanism, etc., are interested in this subject. In each of these fields different conceptual and methodological approaches are applied. The interest of scholars in the subject of the extinct settlements has not been more extensive since the second half of the twentieth century. The first researches, which were mainly taken up by archeology, were directed to the research of the extinct settlements during the Middle Ages and the Early Modern Period (Nekuda 1975); only later on, the interest in this issue was also applied for the 19th and 20th centuries, when the extinction of settlements began to be caused and later dominated by new factors such as urbanization, exploitation or militarization of the cultural and settlement landscapes, which opened up space for research on this issue also for more social and natural sciences. A specific place in the research of the extinct settlements as well as the broader concept of the changes in the cultural landscape and the history of the settlement is occupied by the area of the Czech border region, especially in the period after 1945, as there were specific transformations, extraordinary migration of the population and increased destructive activities resulting from the newly established function and the mission of this space.

Researchers' activities devoted to the topic of extinction and the search for causes of the extinction after 1945 have already been published in a number of specialized monographs and case studies and various popularization works. Significant contributions to this topic can be found in the production of geography, especially historical geography, settlement geography or cartography (Anděl, Poštolka 2004, Kučera 2007), archeology (Bureš 2015), historiography (Kovařík 2013a) or culture studies and in the outcomes of other scientific disciplines. The contribution of regional history is particularly important for this theme (Binterová 2006; Boháč 2007; Kintzl 2015). From the perspective of defining the reasons for the extinction of settlements, there is a relatively extensive literature dealing with military conquests (Glonek 2007, Tomíček 2006), settlements flooded in water reservoirs (Cacák, Kouba 2008, Binterová-Děd 2004), or settlement extinct due to mineral extraction (Prokop 2001, Sýkorová 2002, Spurný 2016), possibly due to the construction of power plants.

Most regional works, however, are structured and dealt with primarily as a simple list (guide) of specific extinct settlements, supplemented only by a brief historical development and basic statistics without a deeper description, a more comprehensive extinction analysis or monitoring of the current state of the site. Many of these works are then based on the collection of period photographs and other visual material, or the comparison of "old pictures" with the current state of the extinct settlement.

The theme of the extinct settlements in the Czech border region after 1945 cannot be examined without its introduction into a wider societal and period context. In order to understand this fact, we can use a number of other works related to economic, social, demographic and political changes in the region we are pursuing and the time period under review.

The analysis of the post-war development of the Czech border region was dealt with by many scholars, while the issue of post-war migration represents a significant place in the research, which was presented either in the form of source editions or contributions to individual migration processes in the border region, such as the

issue of the forced displacement of Germans from Czech (Arburg, Dvořák, Kovařík 2010), post-war settlement of the border (Čapek, Slezák, Vaculík 2005, Nosková, Tošovská 2014) or the creation of new social, economic and cultural structures in the border region (Gerlach 2007; Spurný 2011; Topinka 2005). An important position in the research of the Czech border, which is valid especially for the period of the Communist regime in Czechoslovakia (1948-1989), has the work on the operation of the power and security authorities, especially in the context of guarding and border security (Jílek et all. 2006).
In the literary production dealing with the topic of the extinct settlements, besides the contributions describing and documenting the individual phases of settlement, physical and administrative extinction, searching and explaining the motives and causes of these processes, there are also works dealing with the phenomenon of extinct settlements as a specific place of historical memory. In the interdisciplinary perspective and across the disciplines of science, the core work dealing with the topic of historical or collective memory, offering its theoretical and methodological basis, is applied (Asmann 2001; Nora 1998; Maslowski; Šubrt 2014). A number of works also deal with the theme of "landscape memory" in various approaches (Maur 2006) or specific places of historical memory in the landscape, such as small sacral monuments (Hájek, Bukačová 2006) or cemeteries. Another chapter is research of collective memory in creating and maintaining a regional or ethnic identity of the population. In regional research, the theme of "memory" in connection with extinct settlements and borderland changes occurs in various projects that encounter different interdisciplinary approaches (Salzmann, 2015), sometimes also linked to the non-scientific sphere, for example in the form of artistic activities.

Conclusion

As part of the research of landscape memory, more and more authors focus on the so-called living memory of the landscape, which differs from the common concept of landscape memory by connecting the older past and the physical form of space with the locals and their life stories. This phenomenon also involves the use of the method of oral history and work with witnesses, for which we can also use the necessary specialized literature providing a theoretical and methodological basis (Hlaváček 2012, Vaněk et al., 2007) as well as practically focused work using interviews with witnesses for approaching specific topics. The issue of extinct settlements as one of the processes of post-war transformation of the landscape can also be explored from the perspective of a landscape-ecological analysis of changes in land use. Structural changes of the landscape can be analyzed in a relatively good quantitative and qualitative way, evaluated and knowledge transposed into decision-making processes and planning tools. However, the social and mental dimension of these changes is very rarely used in the research of the dynamics of cultural landscape, and these mental relationships are often decisive for shaping local identity and stabilizing rural settlements. Local identity linked to cultural landscape often plays a role in the development of regions.). This relationship can be used to develop (often marginal) rural areas, especially with a focus on using tourism development and building a development strategy on regional unique ties.
Through its identity research in response to the cultural landscape. Moore, Whelan (2007) deal with the case report (Anglo-Saxon countries) and the complex relationships between identity, memory, cultural heritage and cultural landscape in their book. However, collective (as well as historical or social) memory in the context of cultural landscape, its dynamics and role in identity formation is relatively neglected in research (both nationally and internationally). Complementing the

comprehensive research of the cultural landscape and this dimension of knowledge would be very necessary, innovative and practical.
Extinct settlements are also a subject of interest in modern technologies, especially geoinformatics, in performing various visualizations and creating 3D models of historical reconstructions of these objects.

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Souhrn
Sídelní strukturu České republiky lze v posledních desetiletích hodnotit z kvantitativního hlediska jako stabilizovanou. Počet sídleních jednotek zůstává téměř neměnný (dochází pouze k administrativním proměnám), z hlediska dynamiky připomeňme spíše kvalitativní změny sídelní struktury, např. plošný rozvoj stávajících sídelních jednotek či naopak ztráta původní funkce sídla. Na našem území však můžeme také nalézt velký počet fyzicky zaniklých sídel, jejich původní funkce je překryta jiným způsobem využití území a historický odkaz se nevratně vytrácí. Tato území v kontextu kulturního dědictví však skrývají velký potenciál pro rozvoj regionu. Připravovaný výzkum, jehož vstupním cílem je vytvoření regionální databáze sídel na území Moravy a Slezska zaniklých po roce 1945, se právě zaměřuje na analýzu kvalitativních i kvantitativních proměn takto vymezených sídel s cílem zvýšit využitelnost jejich potenciálu v územně plánovací praxi, v rozvoji cestovního ruchu a v rámci výchovy a vzdělávání. Existuje řada výzkumů zaměřených na studium změn krajinné a sídelní struktury, jejich hodnocení má však většinou kvantitativní charakter, zatímco kvalitativní hledisko chybí, stejně jako aspekt lokální identity. Pro pochopení všech souvislostí sledovaného problému (příčiny zániku sídel, současné funkce sídla, vlivu na dynamiku krajiny, reflexe ve vnímání místních obyvatel, role lokální identity apod.) a pro komplexní interpretaci těchto jevů a procesů je nutné aplikovat interdisciplinární přístup založený na teoretických východiscích a metodách společenskovědních a přírodovědných

disciplín. Připravovaný výzkum kombinuje krajině-ekologické hodnocení vývoje vymezených území s výsledky orálního výzkumu. Cílem tohoto příspěvku je zejména sumarizace současného stavu poznání.

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Říkáme si zkrášlovači krajiny. Zabýváme se obnovou a zakládáním nových prvků zeleně v krajině nebo intravilánu. Při naší práci hraje prim selský rozum, poctivá práce a razíme heslo: „Obnovme biotop, vrátí se i druhy na něj vázané."

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Našimi hlavními přednostmi jsou lidský přístup a cílení na konečný produkt, čímž je zlepšení stavu přírody a krajiny.

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